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Linking ecology and culture

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DISSERTATION

Linking Ecology and Culture

Towards a Psychology of
Environmental Degradation

SOCIAL & BEHAVIORAL
SCIENCES



E. Heleen van Haaften



Linking Ecology and Culture

Linking Ecology and Culture:

Towards a Psychology of Environmental Degradation

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Tilburg
op gezag van de rector magnificus, prof.dr. E.A. van der Duyn Schouten,
in het openbaar te verdedigen ten overstaan van
een door het college voor promoties aangewezen commissie
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door

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geboren op 25 mei 1944
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To my children

Preface and Acknowledgement

I am happily taking this opportunity to thank individually, all those who have assisted me in one way or the other with this research project: a project that started already a long time ago. I will limit myself to the past twelve years starting with the research missions in Africa from 1990. Prof. A. van Maaren gave me all the freedom and support to leave and create the necessary networks in the Dogon area in Mali. Ab van Eldijk and Erik Frederiks gave me the needed back up in Holland to write proposals and look after the administrative consequences. The colleagues of the forestry department didn't always understand what I was after, but still endured a social scientist among them.

Dr. Wouter van Beek introduced me to his friends from the Dogon area, and the guidance and hospitality of Dogulu Say and Apomi Say in Tirelli was a delight. Thanks to the help and hospitality of Han van Dijk and Miriam de Bruijn the mission in 1990 became real and started in Douentza to be followed by a long stay in the mission post of the White Fathers in Segue, where father Jan Anthonissen was a wonderful host. Here I did my first interviews with Eli. I was again welcome in 1992 and 1994.

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Without the insights of Paul Driessen I'd never entered China for research. He and professor Yu Zhenrong made it possible to work with a team of eleven students in three different areas. Ineke van Driel looked after the financial support in Wageningen, and I had never any financial problems, which might be called a miracle. Again I'd like to express my special gratitude to the interpreters Jiang Jun, Liu Yanqin, Lu Changjiang, Mao Liuxi, Su Dankai, Tian Shumin, Wang Liwen, Wu Huifang, Yu Dapeng, Yu Kecheng and Zhang Yanli. They did in fact the hard work by doing each more than 60 interviews and on top answering all my difficult questions. We had a wonderful time and were a great team. The hospitality of Mister Sin and the staff of the Research in the Quzhou area created the conditions for becoming a team.

Brian Roberts and Ken Rickert are responsible for the last chapter, which was written on Bribie Island, near Brisbane. I'm grateful for the trust and support.

Rinus Verkooijen was so kind to edit the text of this book during my stay abroad in such a way that it gets accessible. Thanks for that Rinus!

Now I'm left to express my thankfulness to the scientist who saw it all happen, who trusted his students to me in the field and who did all the calculating together with me for more than ten years. Maybe I should have mentioned him at the beginning, but I think he should be mentioned in the end after the overview of all the different people and circumstances that doesn't make a project like this simple. Specially not when one of the partners – me - is leaving the stability of a government tenure and has to survive financially in a totally different way. I'm talking about Professor Fons van de Vijver, who was indispensable. I remember the first talk with him and Professor Ype Poortinga very well. Ype I knew already several years and our fascination for cross cultural psychology was a strong bond, fed by the work of John Berry and several others. Through Fons I learned the necessity of sound statistics and I realized it is a special profession.

My children are more and more abroad. Maybe looking for what I've been doing when I should have been more at home. I dedicated this book to them, as I know it wasn't always easy and thank them for their patience.

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Introduction

Mammadou Diallo, nomadic cattle owner in Burkina Faso and Agung Djuwantoko, settled farmer on Java both need wood for their household to cook. Both live next to a national park, which is controlled by the regional organization of the ministry of forestry and both live under the threat of severe punishment if they cross the boarder of the National Park to get some wood when this is not available elsewhere or too expensive. In both cases there is a high chance that the controlling agent of the national park is a member of their close family, which heightens the tension to get a little bit of wood for existence living. In both cultures it is 'not done' to punish one's family members for misdeeds like this. In both cultures there does not exist a division between public and private life that goes together with the kind of management implemented by forest services all over the world.

The physical environment is a crucial context of human behavior, especially noticeable in degrading environments. Strong degradation may result in the complete loss of primary resources and of food and income of local populations. Scholars from many disciplines become more and more aware of the mutual relations between preservation of the physical environment and cultural continuity, amid concerns for the needs of growing human populations (Berry, Segall, & Kagitcibasi, 1997). Sociopolitical and technological changes that tend to follow Westernization processes and exert increased pressure on scarce natural resources, often accelerate environmental degradation (Berry & Kim, 1988; Von Laue, 1987). The latter involves a number of related processes, such as deterioration of soil structure, loss of nutrients from the soil, and reduction of biomass (e.g., number and species of wildlife) (Kessler & Laban, 1994; Van Keulen & Breman, 1990). The effects can be reinforced by an increased tension between individual and collective needs, as illustrated in the 'tragedy of the commons': by overusing a natural resource, individuals maximize their own short-term outcome and may ultimately destroy the resource (Hardin, 1968). In sum, environmental degradation has both biophysical and psychological consequences.

One should take in mind that during the past decades the scale of space for food production has changed profoundly, as a consequence of technological changes. Agriculture has become a global activity, organized by multinational food industries. This leads to major cultural changes at the local level often combined with westernization. These changes challenge sustainable production.

The existence of different perspectives for assessment of sustainability of agricultural development has been pointed out by several authors (e.g., Giampietro, 1997). In spite of minor differences in definitions, there seems to be agreement that at least three fundamental perspectives should be considered to assess sustainability:

- The ecological view: agricultural techniques must be environmentally sound;
- The economic view: agricultural techniques must be economically viable;
- The social view: agricultural techniques must be acceptable to farmers and society, given culture, ethics and religion.

Sustainable management presupposes more and more participative management. The success of such management can be strongly affected by psychological factors. For example, degradation processes trigger reactions, such as apathy and disinterest, which will impede participative management.

Even though in many countries environmental degradation is a serious problem, its psychological aspects have received scant attention. The present series of studies reports about an ongoing project in which an attempt is made to examine which psychological variables are involved in environmental degradation and how they interact with physical variables.

The central question put is:

Under what circumstances do farmers employ sustainable methods?

In forestry as well as agriculture, management of natural resources is under stress. Land degradation in many of the world's poorest developing countries may have devastating effects on production in agriculture by the year 2020 (IFPRI, 1999). It has dramatic effects in specific countries and sub regions of the world. Different types of degradation, such as soil erosion, salinization, and agrochemical pollution, will eventually destroy the land, minimizing crop yields. Africa, Asia, and Latin America have the highest rates of land degradation. Many books have been written and many studies have been done to analyze the reasons for the situation from which humankind does not seem capable to escape despite good intentions. It is amazing to see how answers were not found in respect of how to control human behavior in relation to sustainable agricultural production or sustainable management of natural resources in general.

The Model

For the delineation of theoretical concepts and empirical indicators of sustainability of the social environment we use a model developed by cross-cultural psychologists (Figure 1). The focus is on the human perception of the environment, because this provides information of importance for the actor's response to sustainable use of natural resources.

The delineation of theoretical concepts and empirical indicators of sustainability of the physical environment turns out to be difficult. Mulders and Wiersum (1995) argue that definitions of ecological factor are plagued by confusion; various disciplines have different concepts and methods that cannot be easily combined. Several indicators of land degradation and deterioration of land-use conditions have been proposed (Kessler & Berman, 1995; Poels, 1994; Rappenhöner, 1989; Rapport et al., 1985; Van Dijk, 1992).

Psychologists researching stress explain human (and animal) reactions to demanding

environments. These reactions depend on expectations. If the environment does not correspond with their expectations, humans will try to change the environment. Successful actions in this respect are called ‘normal coping strategies’. Continuing unsuccessful actions can lead to pathological behavior, such as depression or marginalization (see, for instance, Frijda 1987). Cross-cultural psychologists believe that individual behavior can be understood only when both biological and cultural features of our species are taken into account. Berry et al (1992) explain in Figure 1 how humans are living in a physical as well as cultural environment, on which they perceive and in which they act in a bio-cultural way (Van Haaften, 2000). This model is used here to grasp the dynamics of human behavior in relation to sustainability. The flow in this model is from variables at the population level to variables at the individual level, influencing the individual outcomes. This reflects the view of cross-cultural psychologists that individual and group differences in psychological characteristics are a function of antecedent factors at the population level. For instance, individual farmers (or groups of) farmers may display different behaviors to similar social pressures, such as the extinction of certain kinds of plants.

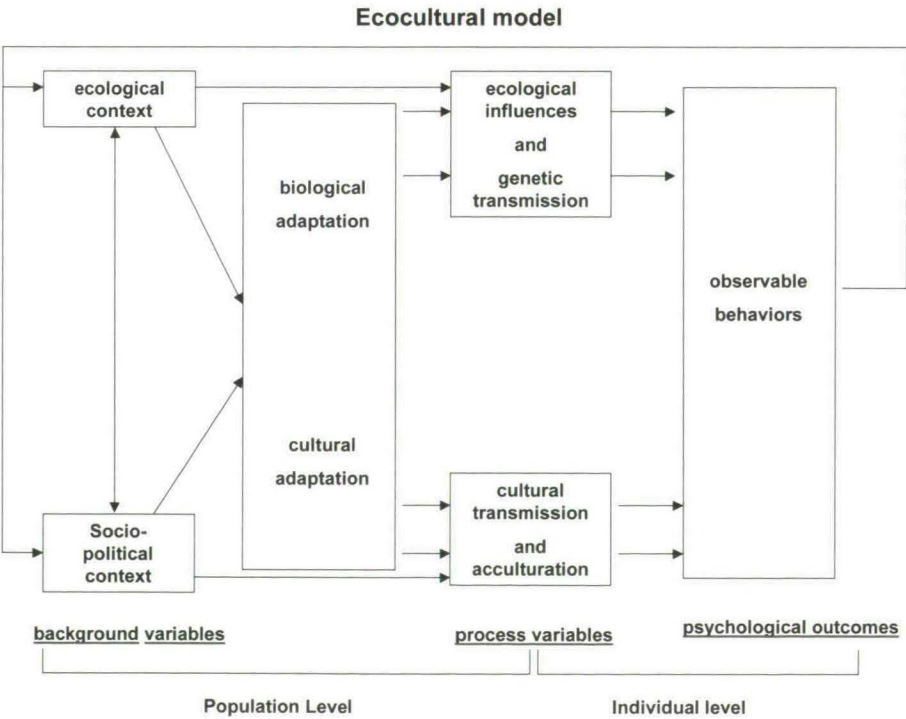


Figure 1. Ecocultural model (after Berry et al., 1992)

A central concept in the studies reported in the following chapters is 'resilience' or 'carrying capacity'. This concept refers to the maximum load that humans, or the land they live on, can deal with without incurring long-term damage. The concept of resilience (carrying capacity) has strong interdisciplinary aspects; the present studies address psychological and biophysical perspectives, with the relationship of psychological and biophysical resilience as the central issue. The model is highly complex, due to the vast number of variables involved; the model cannot be tested in a single project. Therefore, separate partial tests of the model have been carried out. Already in an early stage the research was focused on the question:

'When do farmers *not* employ sustainable methods?'

An attempt was made to indicate what certainly is not sustainable, as constraining conditions are easier to indicate than sustainability for complex systems like we studied. The complexity of those systems is similar to the complexity of life itself.

Broadly speaking three kinds of populations can be distinguished in respect of agricultural production: gatherers/hunters, settled farmers and urban citizens. Hunter/gatherers have almost disappeared from the globe (together with their knowledge), and populations of farmers in western societies are declining to less than 5% of the total populations. We are heading toward large populations of urban citizens that have little appreciation of the environment or the basic behavior that is needed for sustainable use of natural resources to get food. This seems to be becoming the future for large parts of Asia, Africa and Latin America as well.

The shrinking size of rural populations, who are able to grow food and fibre, makes agricultural production more and more dependent on technological developments. A major challenge arises from the fact that so far scientific developments have not prevented environmental degradation at a global scale. A report by IFPRI (1999) records severe degradation over the past fifty years of:

- 18 percent of forest land
- 21 percent of pasture land
- 37 percent of cropland.

In spite of this situation and an increased search for solutions, so-called chain management (vertical integration) of agricultural production administered by large firms remains the dominant model for food production. In this model food production is controlled by large multinationals from 'paddock to plate'. It is almost certainly a dangerous development, as agriculture differs in essential ways from the manufacturing industry. The ecosystems in which we produce are highly complex and cyclical. In addition our environments are part of our mental and cultural life such that they cannot simply be transformed into the requirements for a simple linear economic production chain.

People concerned with management of natural resources know that neither the environment nor most human cultures are inherently democratic or participative. In the near future agriculture as the interface between nature and culture will require considerable democratic skills to manage their national resources. Resource conditions usually only seriously affect production (and stress level), when degradation reaches an advanced, perhaps irreversible stage. Examples of such extremely degraded environment can be found in both developed and developing countries.

The question of sustainability and resilience is interlinked with two topics that exist in psychology and in agricultural sciences already for a longer time:

- psychological assessment from a cross-cultural perspective and,
- interdisciplinary research,

In the first place we had to examine whether psychological instruments, developed in and for Western countries, were appropriate for use in field situations in Africa (Burkina Faso, Ivory Coast and Mali) and China.

The interdisciplinary part of the project in which psychological and ecological variables were to be linked was more difficult. As is shown in the following chapters, a firm link could be established between environmental degradation and mental resilience. The bad health situation of local farmers and nomads in many places seems to reflect this relationship. So, why isn't this aspect of human health part of the management of natural resources? Maybe the simplest answer is that many disciplines do not consider the social dimension as a genuine part of management and underrate the role of farmers and nomads in the interface between culture and nature.

Most agricultural systems try to maintain sustainability and keep the heritage in a good condition for future generations. Probably that is the most basic option for all cultures. So, when farmers react negatively on a cognitive level, like in our studies, one should be very suspicious about the adaptive qualities of changes that have taken place in the recent past. Most probably there is no balance between the three perspectives mentioned before: the ecological perspective, the social perspective and the economic perspective. One could argue that the problems of sustainability in the first place result from the western science driven cultures that have reduced reality too much in monodisciplinary studies and that were not able to listen to and incorporate experiences of local populations. The current project set out to assess these experiences.

After the introduction, **Section 1** reports studies on the empirical use of psychological instruments in culturally very different situations, and their outcomes.

In **Chapter 1.1** a model of psychological factors in effective forest management is proposed. A study in Côte d'Ivoire is described in which psychological stress and marginalization are analyzed among individuals living near forests that show different degrees of degradation. Human resilience to deal with consequences of environmental degradation has a central position in the model.

In the study of **Chapter 1.2** psychological reactions to environmental degradation were studied among Sahel dwellers, who live in environments with different degrees of soil degradation. The degradation was assessed in terms of vegetation cover, erosion, and loss of organic matter.

In **Chapter 1.3** psychological aspects of environmental degradation were studied among 753 Chinese farmers. A structural equation model was fitted to the data. A good fit was found for a model postulating a relationship between various input variables (i.e., environmental degradation, socio-economic status, education, coping, and locus of control), a latent variable (called resilience), and three output variables (stress, marginalization, and depression).

Section 2 reports findings from interdisciplinary research. In **Chapter 2.1** the model, used to explain and approach interdisciplinary problems of sustainability is shortly discussed. The apparently universal relationships and the problems that have been identified are the subject of this article. These issues are discussed in the context of sustainable agricultural production.

The interdisciplinary aspects of the concept of resilience are described in **Chapter 2.2**. The central focus of this study of Fulani pastoralists in the Sahel is the relationship between psychological and biophysical resilience, quantified by a structural equation model of the relationship between psychological and biophysical indicators.

Chapter 2.3 is not an empirical study but an essay, written on invitation, about the the future of farming in the new century. The ecocultural model of the Cross-Cultural Psychologists is the basis for our discussions for this chapter and added agricultural production as the interface between the sociopolitical and ecological context. We are heading toward large populations of urban citizens that have little appreciation of the environment or the basic behavior that is needed for sustainable use of natural resources to get food. This seems to be becoming the future model for large parts of Asia, Africa and Latin America as well.

In the **Epilogue** results are summarized and recommendations for future research are discussed.

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Section 1

Psychological Assessment:

Towards a development of tools to measure the impact of degradation on psychological functioning



Dogon village



Farmers in Segue prepare land for seed



Loss of soil structure

Chapter 1.1

Psychological Stress and Marginalisation as Indicators of Human Carrying Capacity in Deforestating Areas

E. Heleen van Haaften, & F.J.R. van de Vijver (1996).

Psychological stress and marginalisation as indicators of human carrying capacity in deforestating areas. *The International Journal of Sustainable Development and World Ecology*, 3(3), 32-42.

Abstract

A model of psychological factors in effective forest management is proposed. A central role in the model is played by human carrying capacity, the resilience to deal with consequences of environmental degradation. Stress and marginalization are taken as indicators of human carrying capacity. A study in Côte d'Ivoire is described in which psychological stress and marginalization are studied among individuals living in environments which show different degrees of degradation. A first hypothesis stating that individuals living in or near a degrading forest are more stressed and marginalized than individuals in a reference group living in Abidjan was only confirmed for stress. A second hypothesis according to which people living near the forest with the most enduring and most severe degradation would report more stress and marginalization, was confirmed. Females were more stressed and marginalized than males, as predicted. The final hypothesis, stating that members of autochthonous cultural groups show higher stress and marginalization levels than members of migrant groups was partially confirmed. Implications are discussed.

KEYWORDS: Stress, marginalization, environmental degradation, tropical forests, West Africa.

Introduction. Deforestation and sustainable forest management

Forest management has changed during the last decades. Traditionally, the forest services in developing countries took over the forest organization of their colonial rulers (Gillis, 1988; Bergeret, 1993; Parren, 1994). These services managed the forests with a semi-military control organization. Policies like participation of the local people and communication with the local people were not practiced. In regions where the pressure on natural resources became high, there was a growing insight that tensions between forestry personnel and local population were counterproductive. A more active involvement of the local people, labeled participative forest management, is taken to lead to more favorable results in the battle against the common enemy of environmental degradation (Sarin, 1993). It is increasingly appreciated that forest management and reversal of degradation processes can only be successful when people living in these areas are actively involved in the change processes required. Their motivation to cooperate with forest management teams and willingness to invest effort that leads to long-term environmental changes will depend on a variety of factors. Some of these are psychological, such as the consequences of the often substantial cultural change processes in developing countries. The combination of ecological and social aspects amounts to sustainable forest management.

The concept of sustainability has a long history in forestry. Recently, this concept has regained interest, though with a somewhat broadened meaning (Mulders & Wiersum, 1995). Whereas in the past sustainability was associated with ecological characteristics

such as environmental conditions indicated by soil and vegetation conditions, current conceptualizations also consider issues of land use planning such as land quality and limitations on intended use.

In response to the demand to develop timber certification schemes in sustainable forest management, several efforts are underway to identify a set of operational criteria and indicators, including both ecological and social aspects (Bass, 1995). Important differences in degradation processes can be found between various land use systems depending on whether they are based on natural or man-made regeneration and on whether human activities are predominantly exploitative or resource conserving. Unfortunately, the delineation of theoretical concepts and empirical indicators turns out to be difficult. Mulders and Wiersum (1995) argue that a definition of the ecological aspects is plagued by confusion because various disciplines are involved and their concepts and methods cannot be simply combined. Several indicators of land degradation and deterioration of land-use conditions have been proposed (Rapport et al., 1985; Rappenhöner, 1989; Poels, 1990, 1994; Van Dijk, 1992; Kessler & Breman, 1995). Poels (1994) has developed a broad taxonomy, based on formal characteristics of degradation. In his view, degradation processes differ in type (process), rate (speed), and degree (present state). Indicators are often interrelated such as deterioration of soil structure, loss of nutrients, and reduction of biomass (e.g., number and species of wildlife).

Participative forest management often takes place in degrading environments. Degradation processes may trigger reactions of individuals and groups such as apathy and disinterestedness that need to be taken into account. Despite the obvious relevance of these factors, there is a paucity of studies that explore psychological factors in degradation as a prerequisite of effective forest management. The present study will examine individual and cross-cultural differences in psychological reactions on environmental degradation. In our view, psychological carrying capacity is an essential concept to understand in these reactions.

Carrying capacity

The concept of carrying capacity, originating in psychiatry and ecology, is often applied in systems theory to describe the resilience of a system to cope with a substantial increase of the carrying load such as environmental degradation. Overload can lead to disintegration and even a complete breakdown of the system (Lumsden, 1975; Carry & Weston, 1978). Carrying capacity is used here as a generic name for the psychological flexibility to deal with sudden and large increments of the carrying load.

Carrying capacity may be seen as the outcome of a complex set of both cultural and psychological variables (Kleber et al., 1992). Cultural groups differ in their response and relative success to cope with environmental and cultural changes. The strategies that are applied to deal with major stressors will be derived from the cultural context. The cultural legacies of ancestors will provide tools to shape the processes of coping with rapid change. Norms and values as well as symbols and rituals channel thoughts and

emotions and consequently create opportunities for ways of adjustment (Kleber et al., 1995). These tools are important aspects of carrying capacity. Another important aspect of carrying capacity is the perceived efficacy of these tools. When existing tools are seen as inadequate to deal with the problems, carrying capacity may be adversely affected.

There are no direct measures of (psychological) carrying capacity. However, there is a good deal of theory and there are various adequate measures of presumed consequences of carrying capacity. In the present study we will examine stress and marginalization as manifestations of carrying capacity.

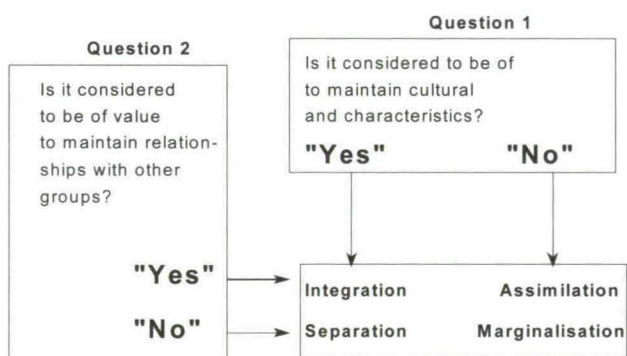


Figure 1.1.1. Four modes of acculturation as a function of two issues (Berry et al., 1992)

Psychological stress

Moderate levels of stress can have positive effects on human behavior. Mild stressors can prepare individuals to take appropriate action. However, changes in the natural and human environment such as environmental degradation are threatening for humans and are often accompanied by high levels of stress (Blaikie & Brookfield, 1987). Processes of acculturation (Berry et al., 1992) also lead to increased stress. Prolonged exposure to high levels of acculturative stress can lead to illness, burnout, depression, and elevated aggression.

A few studies have examined the psychological effects of a sudden loss or threat of loss of essential elements of daily life such as means of subsistence or traditional ways of life. Carry and Weston (1978; see also Giesen, 1991) studied reactions of agriculturalists in Australia to a sudden and serious drop of income. After three financially prosperous years, the Australian dairy sector suffered from various economic setbacks in the period from 1973 to 1976 (high inflation, decline of the meat prices in 1974, and a collapse of the prices of milk powder on the international market). The agriculturalists experienced more feelings of stress, hostility, depression, and anxiety than did a reference group of nonagriculturalists who were not affected by the economic setbacks. Interestingly, individual differences in reported stress were unrelated by income differences but strongly related to the reported feeling not to be able to meet the expectancies of themselves or the environment.

Lumsden (1975) examined psychological consequences of the construction of the Akosombo Dam (Ghana) and the creation of Lake Volta, the largest lake ever made by people. During the construction about 80,000 people had to be resettled in 52 new villages. These people had to deal with a variety of stressors, such as job loss, the need to leave the ground of their ancestors, to move to new and smaller houses, and to mix with other cultural groups. After resettlement, Lumsden found an increase in the four indicators that, according to Naroll (1970), show that a group is under high stress: suicides, alcoholism, provocative man slaughter, and witchcraft.

Psychological marginalization

In cross-cultural psychology, there has been much interest in the study of acculturation processes. Acculturation refers to the changes in an individual who is exposed to a new culture as a result of rapid cultural change or migration. Berry defines four types of attitudes to cope with these changes: integration, separation, assimilation, and marginalization (e.g., Berry et al., 1992; see Figure 1.1.1). The four types are formed by combining two questions with yes-no responses. The first considers the relationship with the original culture: Does the individual who is acculturating want or is the individual able to retain positive attitudes towards his or her original culture? The second question considers the same issue in relation to the new culture. Integration is the acculturation style in which positive attitudes with both the old and new culture are sought. It is often associated with a bicultural identity; elements of both cultures are combined in the attitudes and behavior of the acculturating individual. Separation means that the old way of life is maintained with only superficial contact to the new culture. Individuals who opt for an assimilatory style establish good relationships and a positive attitude towards the new culture while the ties with the original culture are lost; they abandon their traditional way of life and fully adapt to the new culture. Finally, marginalization is the acculturation style in which positive relationships with neither culture are sought. The old way of life is rejected and the new culture is not considered to constitute a viable alternative. Marginalization amounts to culture loss. It can occur in the context of rapid cultural change when new and serious challenges have to be met such as environmental degradation or the breakdown of social institutions. Neither the old culture nor the new, often Western culture, are seen as providing the tools to cope with the problems. In its extreme forms, marginalization can lead to severe social disruption. Women, children, old people, the sick are often hardly taken any care of by their relatives or by the community in highly marginalized groups. Also, particular groups are denied access to vital resources by other more powerful groups. Marginalization can even threaten the existence of a cultural group.

All four acculturation attitudes are accompanied by stress, inner conflict, and feelings of insecurity. Integration has been found to constitute the least stressful option, followed by assimilation and separation (Berry, 1992). Marginalization does not mitigate against acculturative stress and can result in lifelong conflicts. De Bruijn and Van Dijk (1995)

have studied the Fulbe pastoralists in Mali. Due to a complex of political, cultural and ecological factors Fulbe groups are marginalized. The authors report that marginalization led for many people to feelings of being lost, of being totally dependent on the circumstances, and of existential insecurity. These feelings were expressed both toward the outside world and Fulbe society itself.

Both stress and marginalization constitute important psychological variables in effective forest management. Mild levels of stress and marginalization do not need to interfere with active participation programs. However, it is unlikely that autochthonous individuals will participate to management programs when they show high levels of stress and marginalization.

A schematic presentation of the role of stress, marginalization and carrying capacity is given in **Figure 1.1.2**. Carrying capacity is influenced both by environmental variables such as degradation and availability of natural resources, and human variables such as coping mechanisms. Perceived changes in environmental variables and human variables have a bearing on an individual's carrying capacity, as manifested in a changed level of stress and marginalization. Changes in the latter psychological variables can in turn lead to changes in environmental variables or coping strategies. The latter is observed when people become so stressed and marginalized that they feel no longer capable to cope with regular demands which will have an adverse effect on their actual coping. The model postulates feedback loops between, on the one side, environmental and human variables, and, on the other side, stress and marginalization. Levels of stress and marginalization can be seen as relevant marginal conditions for participative forest management. Enduring psychological stress and marginalization are leading to frustration of communication and participation; highly marginalized groups do not longer take care of their environments and will not be motivated to participate in forest management programs.

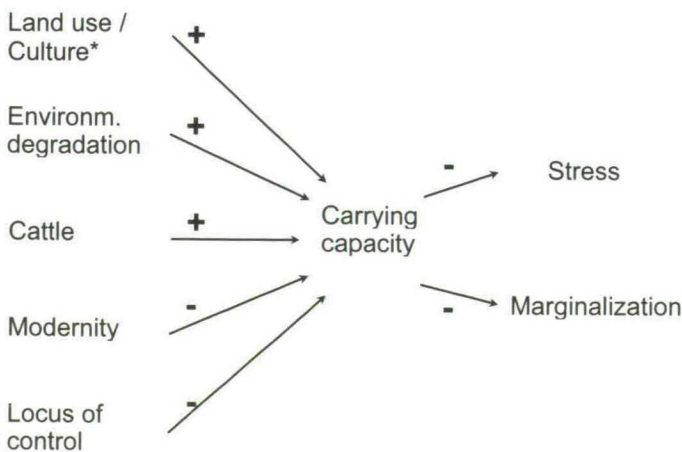


Figure 1.1.2. Relationships between carrying capacity and various psychological and ecological variables

Van Haaften and Van de Vijver (1995) have carried out a test of a part of the model of **Figure 1.1.2**. Psychological aspects of environmental degradation were studied among two groups of Sahel dwellers, namely the Mossi (agriculturalists, $N = 402$) and the Fulani (pastoralists, $N = 160$). Agriculturalists were more stressed and marginalized than pastoralists. Men in both groups scored higher on marginalization and lower on stress than women. This is contrary to the more common finding that women report more stress and marginalization than men. For example, in a study by Chance (1965) it was shown that a loss of traditional roles led to more difficulties in mental health among women. The relationships observed by Van Haaften and Van de Vijver between carrying capacity and various psychological and ecological variables are presented in **Figure 1.1.2**. The figure schematically depicts a confirmatory factor analytic model that yielded an adequate fit. Modern attitudes and an external locus of control were associated with less carrying capacity (and hence, with more stress and marginalization). Coping style and status in the community were unrelated to carrying capacity. It was also found that individuals living in more degraded environments showed a higher carrying capacity. This finding was unexpected. It could well be that individuals react more to the net result of the degradation process (which was higher in the more degraded region) than to the rate of deterioration (which was higher in the less degraded region). The present study will examine the replicability of the finding.

The present study

Côte d'Ivoire, like most West-African countries, is affected by a high pressure on traditional living conditions, induced by processes of cultural change and environmental degradation. If not reversed, deforestation and other forms of environmental degradation may lead to the disappearance of forests and loss of the primary sources of food and income of local people. A CIFOR initiative tries to develop approaches for sustainable forest management. Côte d'Ivoire is one of the countries chosen by CIFOR to develop and test criteria for sustainability. Two forests were chosen as research site. Even though both were degrading, the type, rate and degree of degradation differed.

The present study aims to develop indicators and criteria for evaluating psychological factors that are relevant in forest management. The study builds on our earlier work among Sahel dwellers (Van Haaften & Van de Vijver, 1995). The suitability of stress and marginalization as indicators of carrying capacity is examined. Three hypotheses are tested, which specify a relationship between environmental degradation and stress and marginalization. These hypotheses are as follows:

Hypothesis 1: Groups living in or near the forests show more stress and marginalization than a reference group.

Hypothesis 2: Groups living closer to the forest with more enduring and severe degradation suffer more from stress and marginalization.

Hypothesis 3: Groups from the autochthonous cultural groups show more stress and marginalization levels than persons from migrant groups.



Figure 1.1.3. Schematic map of the research area

Method

Area description

Two forests (Forêts Classées) had been selected to be part of the CIFOR research: Haute-Sassandra and Bossématié. Haute-Sassandra was managed by the forest service SODEFOR and part of the forest was exploited by a German logger. Bossématié was managed by SODEFOR with the support of GTZ, a German development aid company. Pressure on natural resources was high in both forests. The rate of degradation was higher in Haute-Sassandra, while in Bossématié the overall level of degradation of the forest was higher and degradation had started longer ago. Both regions still showed an influx of refugees from more degraded regions.

Two villages were selected in each area: one was located in the forest and the other one was a village in the rural area (see **Figure 1.1.3**). The rural areas were in both cases in highly degraded forest areas that were designated to become agricultural land. The forests played an essential role in all four villages and all villagers were economically dependent on benefits from the forests. Two villages were chosen in the region of Haute-Sassandra: V12 and Dania. V12 was located within the Forêt Classée, while Dania was in the rural area. In the region of the forest Bossématié two villages were selected in a similar way: Bébou, almost in the Forêt.

Table 1.1.1. Number of Participants per Area, Cultural Group, and Gender

Area	Cultural group	Gender	
		Females	Males
Haute-Sassandra	Autochtones (Niaboua)	57	59
	Migrants	51	61
Bossématié	Autochtones (Agni)	47	46
	Migrants	28	23
Abidjan	Various	29	29

Classée and Appouesso more in the rural area. Finally, individuals living in Abidjan who were not exposed to a degrading environment were interviewed as a reference group.

Subjects

In each village samples of men and women, both autochtones and migrants, were interviewed. Both autochtonous cultural groups, the Niaboua (living in Haute-Sassandra) and the Agni (living in Bossématié), are known as hunters, shifting cultivators, and land-owners. During the last decades they cultivated coffee and cacao in the forests, thereby gradually moving from subsistence level farming to participation in a money-based economy. Because the coffee and cacao prices are very low, they were still highly dependent on the forests to generate additional income.

The traditional system of inheritance and succession of the Agni is based on maternal descent, though a married couple resides in the vicinity of the husband's family. They have preserved their traditional social structure. The Agni have adopted much Western material culture, such as bicycles, radios, and sewing machines.

The Niaboua (belonging to the cultural group of the Krou) were originally hunters. Their social structure is patrilinear and gerontocratic (Asselman, 1979).

Migrants play an important role in Côte d'Ivoire. A population growth from three million to thirteen million inhabitants within two decades dominates the demographic constellation of the country and led to an increased pressure on the country's natural resources. The growth stems from two roots: a 'natural' population growth by better health care without family planning and a large amount of immigrants, who are attracted by the richness of the forests in the country. The immigrants are mainly refugees: war refugees from Liberia and ecological refugees from the Sahel countries.

The sampling of persons was done in consultation with the village chief. Respondents were selected in a fairly random way. A total of 430 (218 men and 212 women) individuals were interviewed, of whom 228 near or in Haute-Sassandra and 144 near or in Bossématié and 58 in Abidjan (Table 1.1.1). Of the informants, 84 were Moslems, 164 were Christians, 161 were animists, and 19 mentioned other religions like 'none' or 'Penseur Libre', 'free-thinker' (2 missing values). The vast majority of the participants were illiterate; 346 persons had no or little education, while 84 persons could read and write.

Psychological instruments

Information about various demographic questions was collected: age, cultural group,

gender, number of adult women in the same household (all cultural groups are polygamous), education, religion, organizational membership (number and nature of these organizations), and source(s) of income.

Marginalization was assessed using Mann's (1958) 14-item scale. A short, 20-item version of the general symptom checklist SCL-90 (Derogatis, 1977) was administered to assess stress.

The English questionnaire was first translated into French and later by interpreters into the languages of the cultural groups. A one-day training was given to two Niaboua interpreters, one man and one woman, and two Agni interpreters, one man and one woman. Autochthonous respondents were nearly always interviewed by interpreters from their own cultural group. Allochthonous respondents were interviewed in the language preferred by the respondent the interpreter and known to the interviewer. Respondent and interviewer were almost always of the same gender because in a previous study it was found to be impossible to have women interviewed by men.

Statistical analyses

The statistical analyses were split in two parts. The first one involved the establishment of psychometric properties of the instruments and the computation of factor analyses to scrutinize the construct validity of the instruments. In the second part differences in average scores on the psychological variables were tested. Analyses of variance were computed, with gender, cultural groups, the two forests/areas with a different degree of degradation, and the villages in/near the forests and in the rural area as independent variables and the scores on the psychological tests as the dependent variables.

Results

Reliabilities (Cronbach's alpha) were computed per cultural group (see Table 1.1.2). The stress questionnaires yielded rather high values, ranging from 0.69 to 0.75; the reliability of the marginalization questionnaire was slightly lower though still reasonable, with values ranging from 0.58 to 0.73. Similar reliability estimates were obtained in an earlier study of environmental degradation carried out in the Sahel (Van Haaften & Van de Vijver, 1995). Tests of the equality of the reliability coefficients across the cultural groups did not show significant values ($\alpha = 0.05$ throughout).

For the two questionnaires, marginality and stress, the factorial structure obtained among Western subjects could be confirmed. For both tests a unifactorial solution was obtained (explaining 17.5% of the variance for stress and 20.2% for marginalization).

Table 1.1.2. Reliabilities of the Psychological Measures per Cultural Group (Cronbach's Alpha)

Cultural group	Stress	Marginalization
Niaboua	0.72	0.73
Agni	0.75	0.58
Abidjan	0.69	0.55
Migrants	0.71	0.62

Table 1.1.3. Mean Stress and Marginalization Levels per Gender

Gender	Stress	Marginalization
Females	0.53	0.50
Males	-0.52	-0.49

Table 1.1.4. Average scores on stress and marginalization in the two degraded areas and in the reference group

Area ¹	Stress	Marginalization
Haute-Sassandra	-0.13	-0.25
Bossématié	0.31	0.36
Abidjan	-0.25	0.15

¹ The rate of degradation higher and the overall level of degradation is lower in Haute-Sassandra than in Bossématié.

Table 1.1.5. Averages of Stress and Marginalization in the Villages in/near the Forests and in the Villages in the Rural Area

Area ¹	Location	Stress	Marginalization
Haute-Sassandra	Forest	0.29	0.08
	Rural area	-0.43	-0.49
Bossématié	Forest	0.53	0.50
	Rural area	0.23	0.31

¹ The rate of degradation higher and the overall level of degradation is lower in Haute-Sassandra than in Bossématié.

One-way analyses of variance showed that both marginalization and stress showed highly significant gender differences (marginalization: $F(1, 427) = 106.52, P < 0.01$; stress: $F(1, 427) = 163.73, P < 0.01$). As usual, more stress and marginalization were reported by females than by males (Table 1.1.3).

The first hypothesis stated that individuals living in or near a forest are more stressed and marginalized than individuals in a reference group living in Abidjan. A one-way analysis of variance was utilized to test the hypothesis, with living area (3 levels) as independent variable. The analysis of marginalization showed a significant main effect of living area, $F(2, 427) = 18.87, P < 0.01$. A planned comparison with weights of 0.50 for the two forest/rural areas and -1.00 for Abidjan, did not show a significant effect, $t(427) = -.70, ns$. As can be seen in Table 1.1.4, individuals in the reference group (Abidjan) reported levels of marginalization in between the two other areas. In the analysis of stress, the main effect for living area was also significant, $F(2, 426) = 11.28, P < 0.01$. A planned comparison (using the same weights as in the analysis

Table 1.1.6. Average Scores on Stress and Marginalization per Cultural Group

Cultural Group	Stress	Marginalization
Niaboua	-0.11	-0.13
Agni	0.47	0.57
Abidjan	-0.25	0.15
Migrants	-0.10	-0.28

Table 1.1.7. Average Scores of Females and Males on Stress and Marginalization per Cultural Group

Cultural group	Stress	Marginalization
	Females	
Niaboua	0.45	0.56
Agni	1.16	1.03
Abidjan	0.23	0.53
Migrants	0.34	0.16
	Males	
Niaboua	-0.64	-0.77
Agni	-0.21	0.11
Abidjan	-0.74	-0.24
Migrants	-0.53	-0.72

Table 1.1.8. Average Scores on and Stress and Marginalization per Religious Group

Religion	Stress	Marginalization
Moslem (N = 84)	-0.08	-0.14
Christian (N = 164)	0.25	0.20
Animist (N = 161)	-0.21	-0.18
Others (N = 19)	0.07	0.36

if marginalization) yielded a significant effect, $t(426) = 2.50$, $P < 0.01$. In sum, the first hypothesis could be confirmed for stress but not for marginalization.

An analysis of variance was carried out to test the effects of degree of deforestation (2 levels: low vs. high) and location of living area (2 levels: forest vs. rural area) on marginalization and stress. The main effect of degree of deforestation was significant for marginalization, $F(1, 368) = 42.75$, $P < 0.01$; more enduring deforestation gave rise to higher levels of reported feelings of marginalization (see Table 1.1.5). In the analysis of stress both main effects were significant: deforestation: $F(1, 367) = 25.48$, $P < 0.01$; living area: $F(1, 367) = 31.48$, $P < 0.01$. The interaction was nearly significant, $F(1, 367) = 3.24$, $P = 0.059$. It can be concluded that the second hypothesis stating that groups living near the forest with the more enduring and severe degradation suffer more from stress and marginalization, was confirmed, both for stress and marginalization.

According to the third hypothesis, members of the autochthonous cultural groups were expected to show higher stress and marginalization levels, because the changes in the forests are more consequential for them. An analysis of variance was carried out to test these differences for marginalization. The independent variable cultural group had four levels (Niaboua, Agni, individuals in Abidjan, and migrants living in Bossématié and Haute-Sassandra). The results are presented in Table 1.1.6. The main effect for culture was significant, $F(3, 422) = 23.66$, $P < 0.01$. Agni and, to a lesser extent, individuals living in Abidjan showed high levels of marginalization while Niaboua and migrants living in Bossématié and Haute-Sassandra reported less marginalization. The main effect for gender was highly significant, $F(1, 422) = 137.96$, $P < 0.01$; as reported

earlier, more marginalization was reported by females than by males (Table 1.1.7). The interaction was nearly significant, $F(3, 422) = 2.52, P = 0.057$. A second analysis of variance tested the hypothesized differences for stress. The main effect for cultural group was, again, significant, $F(3, 421) = 13.70, P < 0.01$. As can be seen in Table 7, the Agni is the most stressed group, all other groups reported considerably less stress.

Finally, religious denomination had impact on stress and marginalization scores: the Christians, 'free-thinkers' and individuals without religion suffered significantly more from stress and marginalization than did the other groups (Table 1.1.8). In an earlier study, Van Haaften and Van de Vijver also found that followers of more recently introduced religious denominations showed more stress and marginalization.

Discussion

Environmental degradation may have important psychological consequences, some of which were examined in the present study. An important psychological factor in coping with environmental degradation is carrying capacity. In the present study carrying capacity, as measured by stress and marginalization, was influenced by the degree of environmental degradation and distance to the forest. As hypothesized, stress and marginalization were higher among forest dwellers than among dwellers of rural areas. Respondents of the less degraded forest showed lower scores on stress and marginalization than did both an Abidjan sample and a sample of individuals living in a severely degraded forest.

The influence of area on reported stress and marginalization tended to be much smaller than the effects of gender and cultural group. As expected, females were higher on both stress and marginalization than males. However, the gender differences were not the same across groups. The Agni women reported high levels of stress and marginalization compared both to Agni men and to women of other cultural groups. These high scores may be due to the gender role differentiation among the Agni. The main cultural difference between the Niaboua and the Agni is that the first are patrilineal and the Agni matrilineal. This may have consequences for their relation with the Western organized forest service and, more generally, for the Westernization process taking pace in Côte d'Ivoire. Traditional rights of Agni women are challenged in several ways. Tenure rights have become rather insecure; the transition from a traditional system of tenure rights based on 'palavres' and family to a modern system based on titles and bureaucracy leads to inevitable tension. Tenure rights regulate property and changes in these rights imply an inevitable loss of social security (Rudmin, 1994). Moreover, immigrant refugees from Liberia and from the Sahel who settle in the area, claim and cultivate land that is owned by the Agni despite the absence of any right even though both the Western bureaucracy and the local chiefs ('chefs de village') do not grant them these rights. The diminishing impact of the maternal inheritance system poses a major threat to the traditional role of Agni women. Strong feelings of marginalization may quickly emerge when such traditional roles are challenged. In the Sahel we found a

similar pattern of high stress and marginalization among groups (men in this case) in which traditional social roles were threatened and new roles were only slowly evolving. It is exactly in this 'cultural vacuum' that stress and marginalization are likely to develop and that degradation will lead to marginalization.

In the Sahel we found that men showed more marginalization than women (Van Haften & Van de Vijver, 1995). The question can be asked how this finding can be reconciled with the present results. First of all, the findings may be due to cultural particulars: Agni may always show higher levels of stress and marginalization than Niaboua even when they are not exposed to environmental degradation. We have no evidence to argue for or against this interpretation. Still, another interpretation may be more viable. In the Sahel the men had tenure rights and were confronted with serious challenges of the traditional system of land inheritance. Therefore, the findings of both studies can be reconciled by referring to the ownership of tenure rights and the level of degradation. In sum, women will show higher levels of stress than men for all degrees of degradation. However, marginalization will not show a uniform gender differentiation for all levels of degradation. Females will react more to mild levels. When the environment is seriously threatened and established patterns of subsistence become jeopardized, the gender with the responsibility to take care of the land will show more marginalization.

In the present study two indicators of human carrying capacity were measured, namely stress and marginalization. It was found that the hypotheses were more often confirmed for stress. The question can be raised as to whether stress alone would constitute an adequate measure of human carrying capacity. In our view, this is not the case; variations in stress can be brought about by various factors, only some of which are related to carrying capacity. Moreover, marginalization refers to more severe processes than stress. Stress is more an everyday phenomenon than marginalization.

Conclusion

Psychological stress and marginalization levels have significance for participative forest management in two ways. First, high levels of stress and marginalization can lower the motivation to invest efforts in environmental change and to prohibit adequate communication; highly stressed and marginalized groups may well become inert and may cease to display coping behavior (which in many cases has been fruitlessly applied in the past). The groups can become under so much pressure that they will no longer adapt to changing environments. For governments and forest agents, it is very difficult to keep in touch with psychologically marginalized individuals because they often no longer see any use in being part of a group. They seem to draw back from social life in a fundamental way. Second, groups experiencing high levels of stress and marginalization will be psychologically vulnerable and susceptible to various psychological problems such as depression. Moreover, a growing deficit of proteins (e.g., because of the disappearance of game) as a consequence of degradation may lead to serious health problems.

Participative management may be impossible to achieve among highly stressed and marginalized groups. Neglecting the relevance of psychological factors may well lead to ineffective forest management and to avoidable conflicts between government and local population. Communication problems created by high stress and marginalization levels will be hard to overcome, even by a more active involvement of the local population in the forest management. High levels of degradation will have various social implications which can easily become psychologically more important than the degrading environment such as the need to generate income in an alternative way ('l'exode'), the challenge of traditional roles in society, and a dim future perspective.

Environmental degradation and its psychological aspects form an enduring process with mutual feedback loops. An environment that starts to erode will induce psychological consequences. These, in turn, can lead to behavior that will accelerate degradation. Strong feelings of marginalization can give rise to migration and to a more rapid degradation of the environment. However, the onset of erosion may also lead to behavior that will effectively cope with the threat of a loss of natural resources. The choice of coping strategy has implications for effective forest management. Unfortunately, we do not have much insight in the determinants of the choice or in the dynamics of the psychological processes involved in degradation processes. Additional research on the rate and nature of degradation and additional anthropological research on the differences in stress and marginalization between cultural groups is necessary.

It could be conjectured that the role of psychological stress and marginalization levels in sustainable forestry follows a threshold model: mild or moderate levels will hardly influence communication. However, beyond a threshold level, these processes prohibit efficient communication altogether. Future research will be needed to further specify the critical threshold values and to define social and psychological indicators that are related to these high stress and marginalization levels. Forest management below and above the threshold should adopt wholly different approaches in order to be effective.

Note

The present study was part of the project Testing Criteria and Indicators for Sustainable Forest Management, Côte d'Ivoire, CIFOR Mission, June 2-30, 1995.

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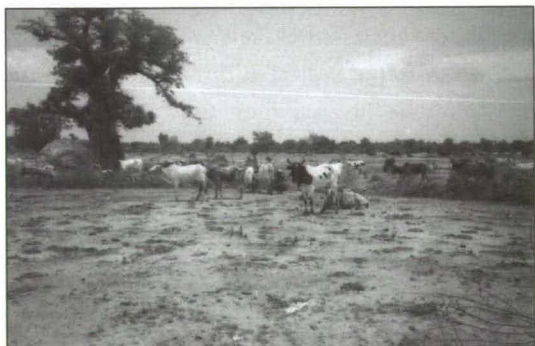
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One of the field teams in Burkina Faso



Fulani village in Mali



Sandstorm over Segue

Chapter 1.2

Dealing with Extreme Environmental Degradation: Stress and Marginalization of Sahel dwellers

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Abstract

Background

Psychological aspects of environmental degradation are hardly investigated. In this study these aspects were studied among Sahel dwellers, who live in environments with different states of degradation. The degradation was assessed in terms of vegetation cover, erosion, and loss of organic matter.

Method

Subjects came from three cultural groups: Dogon (agriculturalists, $N = 225$), Mossi (agriculturalists, $N = 914$), and Fulani (pastoralists, $N = 844$). Questionnaires of marginalization, locus of control, and coping were administered.

Results

Environmental degradation was associated with higher levels of stress, marginalization, passive coping (avoidance), a more external locus of control, and lower levels of active coping (problem solving and support seeking). Compared to agriculturalists, pastoralists showed a stronger variation in all psychological variables across the least and most degraded regions. Women showed higher scores of stress, (external) locus of control, problem solving, and support seeking than men. The interaction of gender and region was significant for several variables.

Conclusion

It was concluded that environmental degradation has various psychological correlates: people are likely to display an active approach to environmental degradation as long as the level of degradation is not beyond their control.

KEY WORDS: environmental degradation, gender, stress, marginalization, coping, locus of control, Sahel

Dealing with extreme environmental degradation: Psychological stress and marginalization of Sahel Dwellers

The needs of growing human populations concern more and more scholars and politicians because of the threatened integrity of the environmental and cultural continuity (Berry & Sam 1997). An example is the south border of the Sahara that moves into the Sahel. In the period from 1980 to 1984 alone, the Sahara desert varied from 8,633,000 to 9,982,000 km² (15% increase, Tucker et al., 1991). The impoverished agricultural conditions are aggravated by occasional periods of severe drought such as in the eighties when the Sahel area was front-page news in the international press. The desertification of the Sahelian countries increases pressure on the already scarce natural resources, causing environmental degradation. Degradation can be operationalized in various ways, borrowing

measures from various disciplines. In an earlier study (in the same area as the current study) we measured degradation by erosion, loss of vegetation cover and organic matter (Van Haaften et al., 1998).

The advancing southern border of the Sahara is destroying the habitat of many species and the source of income and food of several cultural populations such as the three cultural groups involved in this study: the Dogon, the Mossi and the Fulani. The Dogon are mainly sedentary farmers living on the Plateau of Bandiagara in southeast Mali. The Mossi are sedentary farmers, growing millet and sorghum as staples. Agriculture depends heavily on labor of the women. The first arrived lineages are still the authority in matters of access to land, also to the Fulani. The Fulani are a mainly pastoral people; their lives and social organization are dominated by the needs of their herds. The Fulani are dispersed within the kingdom of the Mossi and the Dogon and are locally organized in settlements ('wuro'), which may or may not be attached to a Mossi or Dogon village (Riesman, 1974). The overall exploitation pressure on natural resources was high for a long period of and still lingers on, despite a large emigration stream. As a consequence of these dynamics of man-environment interactions, the former symbiosis between agriculturalists (Mossi and Dogon) and pastoralists (Fulani) is gradually put under more pressure (Lekanne dit Deprez, 1995).

Another process that changes these cultures is the exposure to Western culture and import of Western technology that is introduced to meet the environmental changes. This process of changes in an individual exposed to Westernization as a result of rapid cultural change is called acculturation. Berry defines different types of attitudes to cope with these changes (e.g., Berry et al., 1992; Berry & Sam, 1997). One of these, marginalization, is particularly relevant here. It refers to culture loss, due to a rejection of both the original and the new (Western) culture. Neither the old culture nor the new, Western culture is seen as providing effective tools to cope.

Marginalization is probably better viewed as a state of permanent crisis than as an adaptation mode (Berry & Kim, 1988). Marginalization can have various adverse consequences, both at cultural and psychological level (Kealy 1989; Kleber et al., 1992). At the group level, established patterns of authority, civility, and welfare do no longer operate; at the individual level, depression, apathy hostility, uncertainty, identity confusion, and depression frequently emerge.

Processes of both degradation (Blaikie & Brookfield, 1987) and acculturation (Berry, 1992) are accompanied by stress. Cross-cultural investigations have reported various consequences of stress. Rapid cultural change has been found to be associated with social disintegration and with an increased incidence of psychiatric symptoms (Leighton, 1974; Leighton et al., 1957; Murphy, 1965; Murphy, 1976).

How people deal with environmental stressors in daily life has been examined, among others, by Carry and Weston (1978). They studied agriculturalists in Australia who faced a serious drop of income after a fierce decline of the meat prices in 1974, and a collapse

of the prices of milk powder on the international market in 1976. The agriculturalists experienced considerably more stress and hostility than did a control group of non-agriculturalists. Several agriculturalists suffered from anxiety and depression. Individual differences in stress could not be accounted for by income differences; high stress levels were reported by agriculturalists who reported to fall short of the expectancies of themselves or persons in their environment. Lumsden (1975) examined the psychological consequences of a big resettlement scheme in which 80,000 people had to move after the construction of the Akosombo Dam (Ghana). These people had to deal with various stressors: they often lost their job, had to leave the ground of their ancestors, moved to new and smaller houses, were forced to mix with other cultural groups, and faced hostility of these cultural groups.

Different psychological characteristics have been proposed as determinants of how people deal with stress. The first is coping (e.g., Amirkhan, 1990; Lazarus & Folkman, 1984; Parker & Endler, 1992). Lazarus and Folkman (1984) identified two kinds of efforts to deal with a stressful event: problem-focused and emotion-focused coping. Amirkhan (1990) has developed a questionnaire tapping three coping dimensions: problem-solving, seeking social support, and avoidance (e.g., fantasizing and looking for distracters). The question to what extent these styles are specific to a Western context has not been thoroughly studied.

Locus of control has been more extensively examined in cross-cultural studies. Individuals in developing countries are less internal than those in industrialized countries; men tend to be more internal than women across the globe; internally oriented individuals tend to be more achievement oriented than externally oriented individuals (Berry et al., 1992; Dyal, 1984).

The study reported here is part of a larger project in which environmental degradation is studied from an interdisciplinary perspective, combining psychology, plant ecology, pedology and agricultural sciences. The first project was carried out in Ivory Coast among the Agni and Niaboua. These groups are highly dependent for their daily lives on a rain forest that is rapidly degrading. Stress and marginalization were found to be positively related to the degree of degradation of the rain forest (Van Haaften & Van de Vijver, 1996a).

In another study we examined psychological aspects of environmental degradation among two groups of Sahel dwellers, namely the Mossi (agriculturalists, $N = 402$) and the Fulani (pastoralists, $N = 160$) (Van Haaften & Van de Vijver, 1996b). Agriculturalists were more stressed and marginalized than (nomadic) pastoralists. Men in both groups scored higher on marginalization and lower on stress than women. A MIMIC (Multiple Indicators, Multiple Causes) structural equation model was fitted to the data; the model postulated a causal relationship between four input variables (culture, environmental degradation, cattle, and modernity), a latent variable (called carrying capacity), and two output variables (stress and marginalization). Both for men and women an adequate fit was found, with identical factor loadings and slightly different regression coefficient values for both sexes.

Finally, in a study of the Fulani we interrogated how soil indicators influenced stress and marginalization. The degradation of three contrasting regions was assessed in terms of vegetation cover, erosion, and loss of organic matter. In a structural equation model these indicators could explain 88% of the regional differences in stress and marginalization (Van Haaften et al., 1998). The present study is an elaboration of the study in the Sahel in 1996: the sample size has become more than three times as large and the study is extended to the Dogon.

Method

Participants

Four research sites were chosen with a different availability and current condition of the natural resources: the Segue and Bandiagara region – both Dogon regions – in Mali and the Kaya and the Manga region – both Mossi regions – in Burkina Faso. In the Dogon regions the degradation is strongest and has already led to the migration of agriculturalists. In the two Dogon regions and the Kaya region the temporary migration of ‘Les Jeunes’ (i.e., young men between 18 and 45 years) was more and more needed to support their families.

In the region of Manga pressure on natural resources was much less, as apparent from land degradation indicators (Kessler and Geerling 1994; Van Haaften et al 1998). There was still an influx of agriculturalists and pastoralists from more degraded regions.

The study area was assumed to show four levels of environmental degradation. Reports of the vegetation and soil scientists corroborate the differentiation between the Dogon, Kaya and Manga areas (Kessler & Geerling, 1994). The identification of the villages was done by the economist of the project, with a view of getting a representative picture of all villages in the area.

Table 1.2.1. Number of Participants per Region, Profession, and Cultural Group

		Cultural Group						
		Dogon		Mossi		Fulani		
Region	Profession	F	M	F	M	F	M	Total
Dogon I	Agricult.	27	89					116 (5.8%)
	Pastor.					65	111	176 (8.9%)
Dogon II	Agricult.	64	45					109 (5.5%)
	Pastor.					22	38	60 (3.0%)
Kaya	Agricult.			203	208			411 (20.7%)
	Pastor.					131	141	272 (13.7%)
Manga	Agricult.			238	265			503 (25.4%)
	Pastor.					176	160	336 (16.9%)
Total		91	134	441	473	394	450	1983
		4.6%	6.7%	22.2%	23.9%	19.9%	22.7%	100%

Note. Regions are ordered in decreasing state of degradation F = female; M = Male;

Agricult. = Agriculturalists; Pastor. = Pastoralists

The sampling of persons was done after consultation with the village chief and the resource person. In most villages more than half of the inhabitants (randomly chosen) were interviewed. In the remaining cases, living areas that were representative for the whole village were chosen. In these areas all persons were interviewed. After the identification of the sample, a meeting was organized to explain the villagers the aims of the research. Almost no subjects refused to participate, mainly due to the relevance of the study topic for them.

A total of 1983 (1057, 53.3%, men, 926, 46.7%, women) persons were interviewed, of whom 683 (34.4%) in the region of Kaya, 839 (42.3%) in the region of Manga, 292 (14.7%) in the Northern Dogon area of (Dogon I area) and 169 (8.5%) in the Southern Dogon area (Dogon II area) (Table 1.2.1). Of the total sample 225 (11.3%) belonged to the Dogon cultural group, 914 (46.1%) belonged to the Mossi cultural group and 844 (42.6%) to the Fulani cultural group. As for religion, 1375 (69.3%) were Moslems, 364 (18.4%) were Christians, 222 (11.2%) were animists; 18 (0.9%) persons were atheist (4 missing cases). The vast majority of the participants were illiterate; 1831 (92.3%) persons had no or little education, 95 (4.8%) persons could read and write (57 (2.9%) missing cases).

As can be seen in Table 1.2.1, not all possible combinations of (three) cultural groups and (four levels of) environmental degradation are present. Whereas the Fulani can be found in all regions, the Dogon and Mossi do not live in the same areas.

Instruments

Coping was assessed with Amirkhan's (1990) Coping Strategy Indicator. The questionnaire consists of 33 possible coping behaviors, with three response alternatives ('a lot,' 'a little,' and 'not at all') indicating the extent to which the subject has displayed the behavior after a stressful event mentioned before by the subject. The item 'watched more television than usual' was omitted since no subjects in our sample had electricity in their houses. The item was replaced by 'visited markets more than usual.' Another question on television watching was dropped.

Locus of control was assessed with the Spheres of Control (SOC) of Paulhus (1984), that consists of three 10-item scales, the Personality Efficacy Scale, Interpersonal Control Scale, and the Sociopolitical Control Scale. The subject has to indicate whether he or she agrees or disagrees with each item. The questionnaire was chosen because of its broad coverage.

Marginality was measured with Mann's (1958) 14-item scale. A short 20-item version of the general symptom checklist SCL-90 (Derogatis 1977) was administered to assess stress as stress can become manifest in complaints assessed in this short form of the SCL-90 (Wilson & Kean, 1997). Together with the marginalization scale it indicates the cognitive reactions on environmental change (Van Haaften & Van de Vijver, 1996a).

Table 1.2.2. Reliability Indices of the Psychological Measures per Cultural Group

Cultural Group	Locus of Control	Coping	Marginalization	Stress
Dogon	.48	.84	.66	.83
Mossi	.52	.78	.81	.79
Fulani	.32	.87	.78	.78

Translation of the questionnaires and training of the interpreters

The English questionnaire was first translated into French and later by the interpreters into the languages of the ethnic groups. The back translation into French assured the accuracy of the initial translation.

A four-day training was given to five Mossi interpreters, three men and two women, and two Fulani interpreters, one man and one woman. Interpreters and respondents were nearly always of the same ethnic group. Interviewer and interviewee were always of the same gender.

Statistical analyses

The statistical analyses consisted of two parts. The first one involved the psychometric properties of the instruments and construct validity using factor analyses. Secondly, differences in average scores on the psychological variables were tested in analyses of variance, with gender, cultural group, and level of degradation as independent variables.

Results

Reliability indices (Cronbach's alpha) were computed per cultural group for each of the psychological instruments (see Table 1.2.2). Adequate values, ranging from .66 to .87, were found for coping, stress, and marginalization. Lower though not uncommonly low values between .32 and .52 were found for locus of control (cf. Dyal, 1984). Tests of their equality across cultures as described by Hakstian and Whalen (1976), did not show any differences ($p > .05$). To test their inter-rater reliability the scores on stress and marginalization were correlated in a sample ($N = 134$) of subjects that were questioned two times with a time interval of two to four years. The stress levels correlated .50 ($p < .01$) and the marginalization levels .24 ($p < .01$).

Prior to the exploratory factor analyses, scores on all items of the psychological instruments were standardized per gender and cultural group in order to separate individual differences from confounding gender and cultural differences. The Coping Strategy Indicator yielded a clear three-factorial solution. The factors explained 34.5% of the variance (eigenvalues: 6.75, 2.25, and 2.02). Amirkhan (1990) observed the same number of factors with approximately the same eigenvalues. The correspondence of the present factors and Amirkhan's was examined. In a target rotation procedure (described by Van de Vijver & Leung 1997), our factor loadings were rotated to maximize their agreement with Amirkhan's. Similarity of factors was evaluated using as Tucker's phi; values of at least .90 are often taken as evidence of factorial similarity.

Table 1.2.3. Estimated Effect Sizes ($p < .001$) of the Multivariate Analyses of Variance with Degree of Degradation (D) and Gender (G) and Professional Group (P) as Independent Variables and Marginalization, Stress, Locus of Control, and Avoidance as Dependent Variables per Cultural Population

Most degraded regions							
Source	Multi-variate			Univariate			
		Marginal.	Stress	Locus of Control	Problem Solving	Seeking Soc. Sup.	Avoidance
D	.22	.06	.03		.04	.03	.12
G	.30	.16	.14			.04	.06
P	.16		.04			.06	.09
D x G	.14	.07		.03	.03		.04
D x P	.11		.05		.02	.03	
G x P	.17	.13		.04			
D x G x P	.07						

Least degraded regions							
Source	Multi-variate			Univariate			
		Marginal.	Stress	Locus of Control	Problem Solving	Seeking Soc. Sup.	Avoidance
D							
G	.24	.02	.11	.05	.04	.01	.02
P	.29	.15	.18	.06			
D x G							
D x P	.02						
G x P	.17	.08	.03			.07	
D x G x P	.04					.01	.02

Marginal. = Marginalization. Seeking Soc. Sup. = Seeking Social Support.
Empty cells refer to nonsignificant effect sizes ($p > .001$).

The three factors yielded Tucker's phi values of .94, .88 and .72, respectively. In particular the latter value strongly suggests major differences between the factors. Some items showed their highest loadings on non-target factors. Also, some items showed secondary loadings. This corroborates informal observations that the coping styles are often not seen as distinct options here. An inspection of the factor loadings of the present study did not suggest alternative labels for the second and third factors. Therefore, the original factor labels (problem solving, support seeking, and avoidance) were retained.

Unfortunately, no Western reference data were available for the other psychological instruments. The 14 items of the marginalization questionnaire were factor analyzed. As expected, a scree test showed a clear unifactorial structure; the eigenvalues of the first three factors were 3.76, 1.30, and 1.07. The factor loadings of the items were fairly homogenous. The stress questionnaire revealed an analogous pattern. A scree test confirmed the expectation of a unifactorial solution (first three eigenvalues: 4.17, 1.46, and 1.27). Loadings ranged from .27 to .62.

The results of factor analysis of the locus of control scale were less straightforward.

The deviations of the expected structure of the three-factorial solution were numerous. A scree test did not clearly favor a particular number of factors (first five eigenvalues: 2.85, 2.28, 1.85, 1.72, and 1.55). No solution except for the obvious one-factor solution) could be easily interpreted. It may be noted that problems with the interpretability of factor analyses in non-Western settings are common (cf. Dyal, 1984). It was decided to utilize the total test score in the remainder of the analyses.

The second set of analyses addressed level differences in stress, marginalization, locus of control, and the three coping styles. Because cultural population and environmental degradation were not completely crossed (see Table 1.2.1), a single multivariate analysis of variance could not be computed. As an alternative, two analyses of variance were carried out. The first one involved the two regions with the most severe degradation and compared the Dogon (agriculturalists) and Fulani (pastoralists), while the

Table 1.2.4. Average scores for Marginalization, Stress, Locus of Control, and Avoidance per Gender, Cultural Group, and Level of Degradation

Degradation	Cultural group					
	Dogon		Mossi		Fulani	
	Females	Males	Females	Males	Females	Males
Marginalization						
Highest	25.70	20.24			24.35	22.47
Higher	23.28	20.04			21.32	22.79
Lower			21.42	21.35	17.31	20.28
Lowest			22.21	20.52	17.27	19.99
Stress						
Highest	33.29	28.13			32.82	28.31
Higher	27.36	27.00			33.27	28.84
Lower			32.71	30.84	30.55	26.56
Lowest			32.88	31.65	30.03	25.54
Locus of control						
Highest	45.27	47.93			45.77	44.54
Higher	46.57	45.64			47.14	44.95
Lower			44.34	45.96	46.09	47.13
Lowest			44.80	46.06	46.06	47.97
Problem solving						
Highest	-.45	-.52			-.89	-.57
Higher	-1.17	-.59			-.40	-1.35
Lower			.37	.04	.43	.01
Lowest			.32	-.10	.40	.26
Seeking social support						
Highest	-.27	-.15			.09	-.90
Higher	.10	-.54			-1.06	-1.47
Lower			-.16	.38	.33	.30
Lowest			-.31	.48	.44	.08
Avoidance						
Highest	.27	-.08			1.32	.53
Higher	-.06	-.38			.16	.34
Lower			-.08	.08	-.62	.15
Lowest			-.48	-.10	-.17	-.32

second involved the least degraded regions comparing the Fulani with the Mossi (agriculturalists). In addition to cultural population, degree of environmental degradation (2 levels), gender (2 levels), and professional group (2 levels: agriculturalists and pastoralists) were the independent variables; marginalization, stress, locus of control, and the three coping strategies (problem solving, support seeking, and avoidance) were the dependent variables. The results of the analyses have been presented in Table 1.2.3 and the average scores in Table 1.2.4. In order to simplify the presentation only estimated effect sizes (η^2) have been reported in Table 1.2.3. Furthermore, Type I errors due to multiple testing were controlled by setting alpha at .001. The effect of degree of degradation was much stronger in the area with more degradation ($\eta^2 = .22$ and .01, respectively). With the exception of locus of control, all psychological variables differed significantly across the two most degraded regions.

Gender differences were large in both analyses. Women reported more marginalization and stress than men; the same was found in a study of the psychological consequences of environmental degradation in Ivory Coast (Van Haaften & Van de Vijver, 1996a). Furthermore, men showed a more internal locus of control than women (which is a common finding). It was found that women more actively engaged in all coping strategies. In particular the lower scores of men on problem solving are remarkable. Contrary to the effects of region and gender, the differences of the cultural populations were larger in the less ($\eta^2 = .29$) than in the more degraded regions ($\eta^2 = .16$). In both analyses women showed higher scores of stress, (external) locus of control, problem solving, and support seeking than men. For marginalization women were found to score higher than men in the most degraded regions while the opposite was found in the least degraded regions. A similar reversal was found for avoidance. Whereas women scored higher on avoidance in the most degraded regions than men, their scores were lower than those of men in the least degraded regions. The influence of profession was consistent across all psychological variables, even though not all tests showed significant differences (see Table 1.2.3). The differences between pastoralists and agriculturalists were opposite in the two analyses. For example, whereas in the most degraded regions (i.e., the Dogon areas) agriculturalists showed a more internal locus of control than pastoralists, the opposite was found in the least degraded regions (i.e., Kaya and Manga).

In terms of its estimated effect size, the most important interaction component was between gender and cultural population ($\eta^2 = .17$ in both analyses). In both analyses stress and marginalization showed a similar pattern of larger gender differences among pastoralists than among agriculturalists. Similarly, in the most degraded regions gender differences in locus on control were larger among pastoralists than among agriculturalists. The last significant interaction between gender and professional group was found for seeking social support in the least degraded regions. Unlike the previous interactions, gender differences were larger for the agriculturalists than the pastoralists.

The interaction between degradation level and gender was also significant in both analyses, even though the estimated effect sizes were considerably smaller than for the

gender by professional group interaction ($\eta^2 = .14$ and $.01$, respectively). In both analyses the interactions for marginalization, stress, and avoidance were all due to larger gender differences in the region with the higher degradation (i.e., the first Dogon and Kaya areas). Significant, disordinal interactions were found for locus of control and problem solving were found in the analysis of the most degraded regions. Whereas men were slightly more externally oriented than women in the more degraded Dogon region, the opposite was observed in the second Dogon region. Analogously, while men scored higher on problem solving in the first Dogon area, women scored higher in the second Dogon area. No clear patterning was observed for the significant interaction in the other analyses.

Discussion

All psychological variables showed higher scores in the more degraded region, while the differences across the less degraded regions were smaller. Combining the results of the two analyses, it can be said that across the four regions stress, marginalization, and avoidance increased with the level of environmental degradation. As can be seen in Table 1.2.4, the level of external locus of control also increased with environmental degradation (although the two pairwise comparisons in the analyses did not show significant differences). Problem solving and support seeking revealed significant differences in the most degraded regions. The pattern of findings was complex. In each of the two analyses significantly lower scores on these variables in the more degraded regions were found; however, a visual comparison of the overall means obtained in the most and least degraded regions clearly showed higher scores in the less degraded regions (Table 1.2.4). The question arises how these incompatible findings can be interpreted. We are inclined to opt for the view that there is a negative relationship between degradation and these coping styles, because of the clear overall pattern of the findings: the data suggest that environmental degradation is strongly related to psychological functioning; higher levels of degradation are accompanied by higher levels of stress, marginalization, avoidance, and by lower levels of problem solving and support seeking, and a more external locus of control. In short, environmental degradation is associated with higher levels of psychological discomfort and less willingness to actively engage in behaviors aimed at relieving the problems.

The group of pastoralists shows a large score variation across the regions; their scores on locus of control, support seeking, problem solving, and avoidance tend to vary with environmental degradation. It can be concluded that in the present study pastoralists tend to react more to environmental stressors than agriculturalists do.

In Berry's (Berry et al., 1992) ecocultural framework, gender differences are assumed to be larger in agricultural societies than in pastoral societies. It can be concluded that our data do not support the framework. Most significant interaction components were due to larger gender differences in the pastoral group.

In line with the strong ecological tradition in cross-cultural psychology, psychological

components of environmental degradation have been explored. An increase in degradation was associated with more stress, marginalization, and avoidance, a more external locus of control, and less problem solving and support seeking. Compared to agriculturalists, pastoralists showed a stronger variation in all psychological variables in the least and most degraded regions.

At first sight it may seem that no evidence was found for the widely held view (Berry & Sam, 1997) that pastoralists are less susceptible to adverse psychological conditions because they can move away from the stressor. In the regions with the lower degradation the start of degradation is first perceived as stressful by the agriculturalists who realize much earlier that their means of existence are directly threatened, while the pastoralists still perceive that they can move away from the stressor. In the regions with a longer and higher state of degradation the situation has turned as the pastoralists have become much more cornered and dependent on the agriculturalists, who as the 'owners' of the natural resources (land and water) can easily restrict the access for pastoralists.

Very high levels of environmental degradation are accompanied by less active and more passive forms of coping. It can be conjectured that control is the key issue here: people are likely to display an active approach to environmental degradation as long as the level of degradation is not beyond their control. However, when the degradation continues, people often withdraw from the situation either physically by moving to other areas or psychologically by relying more on passive strategies to deal with the degradation. We found that the level of degradation is psychologically more consequential than the rate. It could be argued that the psychological measures used in the present study have control as a common theme, not just locus of control. Coping is obviously related to (re)gaining control. Control is also an important characteristic of marginalization, being the mental state in which individuals have lost control of their environment in an almost existential sense.

Strong evidence was found that extreme environmental degradation has various psychological correlates. It is a limitation of the present study that the direction of causality cannot be determined. It can be easily appreciated that degradation will lead to negative psychological affect (stress and marginalization), a more external locus of control, more passive coping (avoidance), and less active coping (problem solving and support seeking). However, reciprocal effects may also occur. The onset of environmental degradation may have the psychological consequences mentioned. In turn, psychological consequences such as less active coping may speed up the degradation process. Carefully conducted longitudinal designs would be required to estimate both lines of influence simultaneously. In a forthcoming paper we will address this issue.

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Chapter 1.3

Human Resilience in a Degrading Environment: A Case Study in China

E. Heleen van Haaften, Z. Yu, & F. J. R. van de Vijver.

Human resilience in a degrading environment: A case
study in China

Abstract

Psychological aspects of environmental degradation were studied among 753 Chinese farmers. A good fit was found for a structural equation model postulating a relationship between various input variables (i.e., environmental degradation, socio-economic status, education, coping, and locus of control), a latent variable (called resilience), and three output variables (stress, marginalization, and depression). Higher scores on internal locus of control, problem solving, socioeconomic status, and modernity and lower scores on environmental degradation, avoidance, and support seeking were associated with more resilience.

KEY WORDS: resilience, environmental degradation, stress, marginalization, depression.

Human resilience in a degrading environment: A case study in China

The North China Plain covers an area of 320,000 km² of which 20.8 million hectares are arable land. The plain has top priority in the national regions development plan, as for grain and cotton alone the plain already accounts for 24.8% and 39% of the total national production (Xin Dehui, 1996). The plain suffers from frequent droughts and floods; the lower part is severely salt affected and strongly degraded in the past due to intensive agriculture (Yu & Van Haften, 1998).

Land degradation leads to a decline in the productivity of cropland, pastures, and forests used in agriculture due to poor land management. The United Nations estimate that of the 8.7 billion hectares of cropland, pastures, and forests worldwide, nearly two billion have been degraded over the past 50 years: about 18% of forestland, 21% of pastureland, and 37% of cropland is degraded (IFPRI, 1996). Soil, water, vegetation, landscape, and local climate conditions collectively influence land productivity. Damage to these resources decreases the ability to produce crops, grow trees, and support grazing cattle. Water erosion causes most degradation, while wind erosion is the major damage-causing factor affecting dry areas and cattle grazing lands. In many places soils are losing nutrients and, where irrigation is mismanaged, become salty. Loss of vegetation exposes soils to erosion and threatens the habitat. Major problems caused by land degradation include declining crop yields, sedimentation in rivers and streams, contamination of drinking water by chemicals, diversion of limited water supplies for irrigation, health problems in people, and loss of habitat for animals.

Not only the physical environment changes, the social environment for farmers is also changing profoundly due to technological change, coming mostly from Western cultures and challenging sustainability in several ways. The combination of degradation and adaptation to technological change (Westernization) seriously affects the living conditions of farmers all over the world. Adaptation to changing living conditions at the population level can be understood across cultures only when on individual level both cultural and ecological features are taken into account.

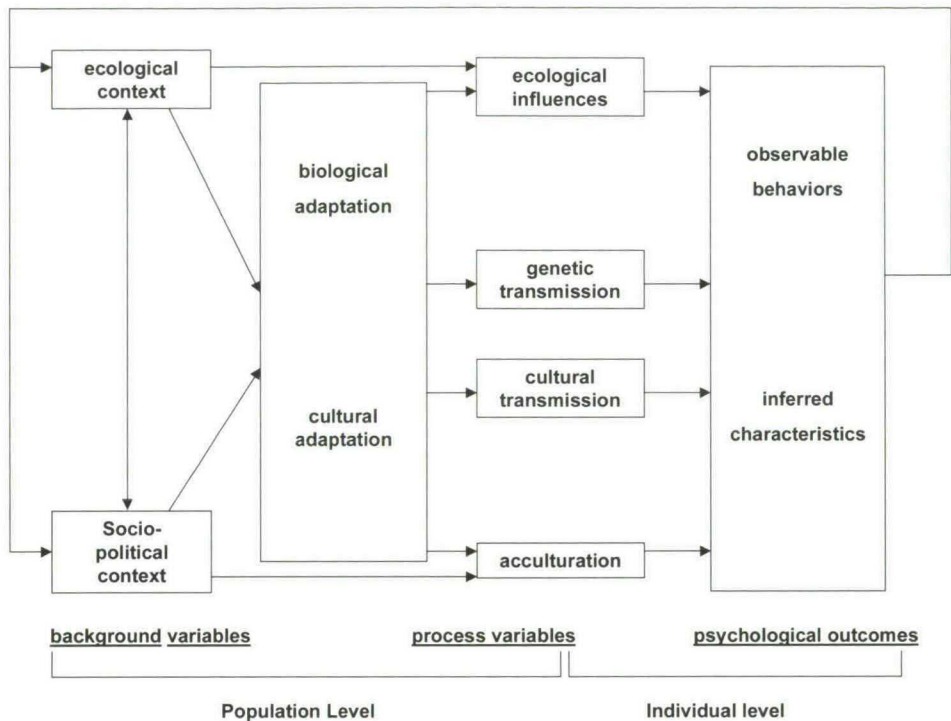


Figure 1.3.1. Ecocultural model (Berry et al., 1992)

The model (Figure 1.3.1) used here to understand the interdisciplinary dynamics of sustainability is the ecocultural model as developed by Berry and colleagues (Berry et al., 1992). These authors suppose that individual behavior can only be understood when both cultural and biological features of our species are taken into account. The flow of the figure goes mainly from population-level variables to individual outcomes. Individual and group differences in psychological characteristics are a function of population-level factors. Farmers may display behavior, due to pressure at community level, such as the pressure currently coming from eco-activists to use agro-industry resources in a more sustainable way. In the current study the relationship between ecological influences and process variables is studied.

Marginalization, stress, and depression

Marginalization amounts to culture loss, which can occur in the context of rapid cultural change when new and serious challenges have to be met, such as environmental degradation or the breakdown of social institutions. Neither the old culture nor the new, often Western, culture is seen as providing the tools to adequately cope with the problems of daily life. In its extreme form, marginalization can lead to severe social disruption (Van Haften & van de Vijver, 1998).

Marginalization is probably better viewed as a state of permanent crisis than as an

adaptation mode (Berry & Kim, 1988; Marsella & Dash-Schreuder, 1988). Marginalization can have various adverse consequences, both at cultural and psychological level (Kealy, 1989; Kleber, Brom, & Defares, 1992). At the group level, established patterns of authority, civility, and welfare do no longer operate; at the individual level, hostility, uncertainty, identity confusion, and depression frequently emerge. At the individual level, depression and apathy may be observed.

Stress

Processes of both ecological degradation (Blaikie & Brookfield, 1987) and acculturation (Berry et al., 1992) are accompanied by stress as stress refers to a challenge to a person's capacity to adapt to inner and outer demands (Westen, 1996).

Cross-cultural investigations have reported various consequences of stress. Rapid cultural change has been found to be associated with social disintegration and with an increased incidence of psychiatric symptoms (Leighton, 1974; Leighton, Clausen, & Wilson, 1957; H. Murphy, 1965; J. Murphy, 1976).

Only a few studies have explored psychological effects of a sudden loss or threat of loss of essential elements of daily life such as means of subsistence or traditional ways of life. Berry et al (1982) studied the Cree ten years after a hydroelectric dam had been built in their living area. Stress and marginalization correlated positively with separation attitudes, and negatively with integration and assimilation attitudes. Cary and Weston (1978) studied agriculturalists in Australia, who faced a serious drop of income after a fierce decline of the meat prices in 1974, and a collapse of the prices of milk powder on the international market in 1976. The agriculturalists experienced considerably more stress and hostility than did a control group of non-agriculturalists. Several agriculturalists suffered from anxiety and depression. Individual differences in stress could not be accounted for by income differences; high stress levels were reported by agriculturalists who reported to fall short of expectancies of themselves or persons in their environment.

In a nationwide study of stressful life events in Mainland China, the Chinese ranking differed from Western ranking: among the Chinese the death of a close family member ranked high, while divorce was ranked lower than in most Western studies (Zhen, & Lin, 1994).

Depression seems to be on the rise cross-culturally (Cross-National Collaborative Group, 1992, World Health Organization, 2001). The causes are still unclear, but these may be related to the enormous social changes that have occurred in the modern areas (Westen, 1996), among others by technological change with the accompanying cultural change. In these processes of change the transactional nature of the relation between coping, stress, and mental health should be acknowledged (Aldwin, 1994). Depression is presumably universal, although the way in which it is expressed may vary across cultures (Marsella & Yamada, 2000). Metaphors, used to describe a depressive mood

state, also vary; according to Kleinman (1988), depressed Nigerians complain that ‘ants keep creeping in parts of my brain’, while Chinese complain that they feel ‘exhaustion of their nerves’ (Kleinman, 1988).

Gender differences in depression seem to appear in adolescence, with women reporting more depressive symptoms than men (Peterson et al., 1993). Men are more socialized to use distraction in response to depressive moods (Nolen-Hoeksema, 1991), while women are more socialized to be attentive to emotional reactions, which may lead them to ruminate about their problems, thus maintaining or leading to depressive feelings (Aldwin, 1994; Ali & Toner, 1996).

Somatization plays an important role in the expression of depression, possibly because Chinese feel embarrassed to express feelings of loneliness and sadness (Cheung, 1996).

The Chinese version of the Beck Depression Inventory (BDI) was found to have high internal consistency and item-total correlations (Cheung, 1996). Two factors, General Depression and Somatic Disturbances, were extracted, supporting the view of depression as a multidimensional construct. Shek (1990, 1991) also found a two-factorial solution with a high internal consistency.

Different psychological characteristics have been proposed as determinants of how people deal with stress, like problem-focused coping and emotion-focused coping (Lazarus & Folkman, 1984). Parker and Endler (1992) proposed three dimensions of coping: task-oriented strategies, cognitive reconceptualization, and minimization of the effect of the stressor.

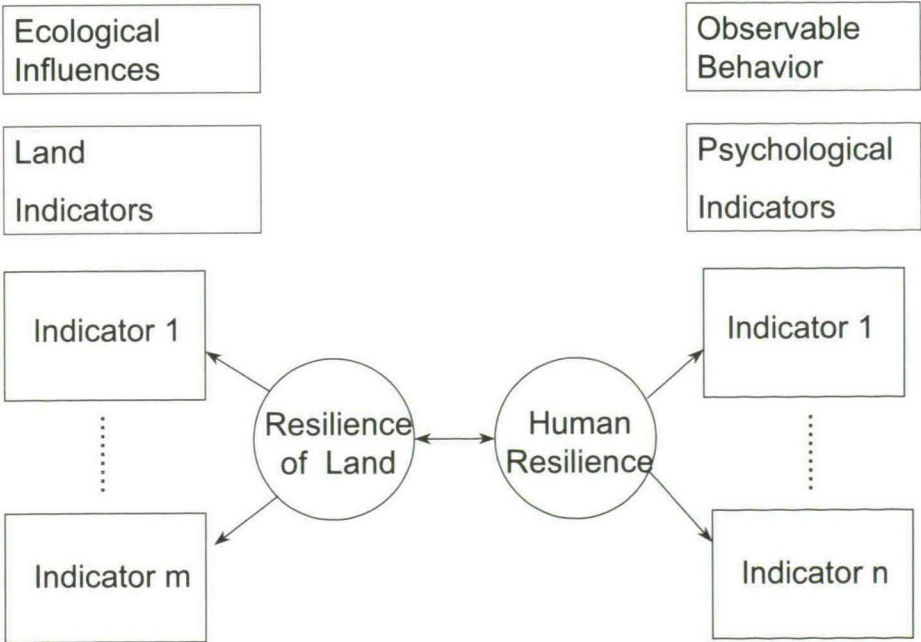


Figure 1.3.2. Schematic outline of the model used

The authors view social support as a resource for coping rather than as a coping mechanism or style. Amirkhan (1990) has developed a questionnaire tapping three coping dimensions: problem-solving, seeking social support, and avoidance (e.g., fantasizing and looking for distracters).

Most research on coping is carried out in Western populations and is focused on individual-level coping (Phillips & Pearson, 1996). Macro-structural factors, of cultural factors and of coping at other levels of social organization have not been adequately explored. Coping research in Chinese communities is largely restricted to cross-sectional studies that attempt to identify the coping styles of Chinese individuals (Phillips & Pearson, 1996).

Locus of control

Locus of control, another important psychological variable in stress research has been more extensively studied from a comparative perspective. Locus of control 'is based on the belief that outcomes (reinforcements) are either due to personal factors (internality) or caused by factors external to the individual (that is, fate, chance or significant others)' (Cox & Ferguson, 1991, p. 17). Ward and Kennedy (1993) found that an internal locus of control promotes psychological adjustment to novel environments. In general, individuals in developing countries are less internal than those in industrialized countries; men tend to be more internal than women; finally, internally oriented individuals tend to be more achievement oriented than externally oriented individuals (Berry et al., 1992; Dyal, 1984). These findings are in agreement with the supposition of Smith et al. (1995) that internals endorse values that are salient in Western individualistic cultures. Because of the collectivist orientation and the Confucianist, Buddhist, and Taoist traditions, Chinese people tend to possess a stronger belief in external control than do Westerners (Bond, 1996). Cross-cultural comparisons of locus of control scales have met serious problems. In a review of such studies, Dyal (1984) pointed out that those cross-cultural comparisons of factor analytic results invariably point to the poor replicability of the presumed factor structure across cultural groups.

It might be typical for Westerners that there is a well-established association between the sense of personal control and psychological well-being. In a study on Asian ethnicity and the sense of personal control it was found that Asian Americans and Asians in Asia report lower levels of perceived control. The sense of personal control had less impact on psychological distress for Asians (Sastry & Ross, 1998).

Theoretical model

The study reported here is part of a larger project in which environmental degradation is studied from an interdisciplinary perspective, combining psychology, plant ecology, pedology, and agricultural sciences (Van Haaften & Van de Vijver, 1996a, 1996b, 1998).

In this general model environmental indicators define the environmental resilience and psychological indicators the resilience of individuals (Figure 1.3.2). The project

examines the influence of environmental degradation on the resilience of individuals.

The first study of the project was carried among individuals who live in a rapidly degrading rain forest in Ivory Coast. Stress and marginalization were found to be positively related to the degradation of the rain forest among the Agni and Niaboua, two cultural groups highly dependent of those forests for their daily life (Van Haaften & Van de Vijver, 1996a). In another study we examined psychological aspects of environmental degradation among two groups of Sahel dwellers, namely the Mossi (agriculturalists) and the Fulani (pastoralists) (Van Haaften & an de Vijver, 1996b). Agriculturalists were more stressed and marginalized than (nomadic) pastoralists. Men in both groups scored higher on marginalization and lower on stress than women. A MIMIC (Multiple Indicators, Multiple Causes) structural equation model was fitted to the data; the model postulated a causal relationship between four input variables (culture, environmental degradation, cattle, and modernity), a latent variable (called resilience), and two output variables (stress and marginalization). Both for men and women an adequate fit was found, with identical factor loadings and slightly different regression coefficient values for both sexes.

Method

Study locations

Three research areas in China (see **Figure 1.3.3**) were chosen with a different level of degradation and availability and condition of natural resources (presented in descending order of marginalization):

- The Quzhou region with the villages Liu Zhuang and Da Jie;
- The 'Mountain region' with the villages Qian Boshan and Men Wang Zhuang;
- The 'Northern region' with the villages Sha Liang and Da San.

The following indicators of environmental degradation were measured in each of the six villages: annual crop rotation, soil situation at the present with respect to salinity, soil profile, vegetation in respect to tree and shrub coverage, and water resources as relevant for irrigation. These data (not further reported here) confirmed the rank order of the levels of degradation of the three regions.

Participants

Of the participants 364 were female and 391 male (see **Table 1.3.1**); 51.8% was older than 35 years old. Twenty percent had no or up to three years of schooling, while 80% had more than four years schooling. More than half of the sample (52.1%) had no cows at all, 28.6% had one cow, 13.4% had two cows. About two-third (67.5%) lived in families of at most four persons. Eighty-two percent had farming as main activity and 50% had less than 0.27 hectares for agricultural production.

The sampling of persons was done in consultation with the village chief in all six villages. In five of them more than half of the inhabitants were interviewed.

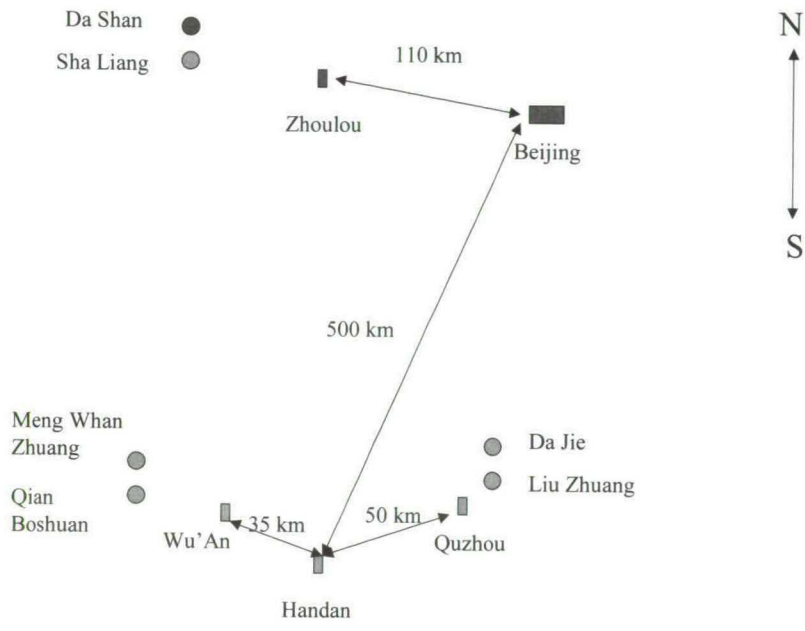


Figure 1.3.3. Schematic map of the research area

Instruments

Information about the following background variables of the respondents was asked: age, gender, household size, sources of income, cattle owned (operationalized as the number of cows plus one quarter of the number of the other cattle such as goats), and amount of cultivated land of the household.

Table 1.3.1. Number of Participants per Region

Region	Sex		Total
	Female	Male	
Quzhou	144	155	299
Mountain area	113	149	262
Northern area	107	88	195
Total	364	392	756

Note. Regions are ordered from most to least degraded.

Coping was assessed with Amirkhan's (1990) Coping Strategy Indicator. This questionnaire was chosen because of its relatively stable factorial structure in Western as well as non-Western contexts (e.g., Amirkhan, 1990; van Haaften & Van de Vijver, 1996a, 1998). The questionnaire consists of 33 possible coping behaviors, with three response alternatives ('a lot,' 'a little,' and 'not at all') indicating the extent to which a subject has displayed a behavior following a stressful event that the participant has recently experienced.

Locus of control was assessed with the Spheres of Control (SOC) of Paulhus (1984), which consists of three 10-item scales, the Personality Efficacy Scale, Interpersonal Control Scale, and the Sociopolitical Control Scale. The participant has to indicate the level of (dis)agreement with each item. The questionnaire was chosen because of its broad coverage. Item 14 ('I can usually establish a close personal relationship with someone I find sexually attractive') was not administered. Item 15 ('When being interviewed I can usually steer the interviewer toward the topics I want to talk about and away from those I wish to avoid') was skipped because it became clear early in the data collection that many participants refused to answer. Item 21 ('By taking an active part in political and social affairs we, the people, can control world events'), 22 ('The average citizen can have an influence on government decisions'), 23 ('It is difficult for people to have much control over the things politicians do in office'), 24 ('The few people in power run this world and there is not much the little guy can do about it'), 25 ('With enough effort we can wipe out political corruption'), 28 ('When I look at it carefully I realize it is impossible to have any really important influence over what politicians do') and 30 ('In the long run we, the voters, are responsible for bad government on a national as well as a local level') were skipped due to their political sensitivity.

Three outcome measures were employed. Marginalization was assessed with Mann's (1958) 14-item scale. Second, a short 20-item version of the general symptom checklist SCL-90 (Derogatis, 1977) was administered purportedly measuring stress. Third, Shek's (1990, 1991) translation of Beck's Depression Inventory (Beck, Rush, Shaw, & Emery, 1979) was used as a measure of depression.

Translation of the questionnaires and training of the interpreters

The English questionnaire was translated by the eleven interpreters (four women and seven men) into Chinese, using a committee approach. A five-day training was given to the eleven interpreters. Interviewer and interviewee were always of the same gender in order to facilitate openness of responses.

Statistical analyses

The statistical analyses consisted of three parts. First, psychometric properties of the instruments and construct validity were determined, using exploratory factor analyses. Second, a MIMIC structural equation model (Multiple Indicators, Multiple Causes) is used to examine the relationship between, on the one hand, psychological characteristics and background characteristics and, on the other hand, the three outcome measures (stress, marginalization, and depression). The psychological characteristics are coping and locus of control, while the socioeconomic status and degree of environmental degradation are the background characteristics. Finally, differences in average scores on the outcome measures were tested in an analysis of variance, with gender and level of degradation as independent variables.

Table 1.3.2. Varimax-Rotated Factor Loadings of the Background Variables

Variables	Factor	
	Status	Age/education
Household size	.74	-.08
Large animals	.39	.09
Small animals	.45	.08
Size of land owned	.83	.01
Age	-.08	-.82
Years of education	.04	.83

Results

Preliminary analyses

In the first part of the data analyses a factor analysis was carried out on the background variables; the analysis aimed at a reduction of their dimensionality which would simplify subsequent analyses. The results of the analyses have been presented in Table 1.3.2. A two-factor solution (Varimax-rotated) was chosen because of its interpretability; the eigenvalues of the factors were 1.65 and 1.33, together explaining 49.6% of the variance. The first factor was labeled status and was defined by household size, ownership of large and small cattle, and amount of land for cultivation. The second factor showed the highest loadings for age (negative) and the number of years of education (positive).

Reliability indices (Cronbach's alpha) were computed per gender group for each of the psychological instruments (see Table 1.3.3). Values ranging from .57 to .84 were found for coping, stress, and marginalization. Lower though not uncommonly low values between .48 and .57 were found for locus of control (cf. Dyal, 1984).

Prior to the exploratory factor analyses the scores on all items of the psychological instruments were standardized per gender in order eliminate confounding gender differences.

Coping. The Coping Strategy Indicator yielded a clear three-factorial solution. The factors explained 29.3% of the variance (eigenvalues: 5.41, 2.25, and 2.00). The same number of factors was observed by Amirkhan (1990).

The correspondence of the present factors and Amirkhan's was examined. In a target rotation procedure (cf. Van de Vijver & Leung, 1997), our factor loadings were rotated to maximize their agreement with Amirkhan's. If the correspondence of an item is defined as having the highest loading on the same factor, 29 out of 32 items (90.6%) loaded on the same factors in the two solutions. The three items with their highest loadings on different factors were: 'daydreamed about better times,' 'visited markets more than usual' (item was rephrased by us), and 'fantasized about how things could have been different.' Each of these items loaded highest on the avoidance factor in Amirkhan's data and on one of the other factors in our data. A statistically stricter definition of factorial correspondence in which the size of the loadings is taken into account yielded more negative results. Although we adopted Amirkhan's labels of the

Table 1.3.3. Reliability Indices of the Psychological Measures per Gender

	Females	Males	All participants
Coping (overall)	.81	.80	.80
Problem solving	.71	.68	.70
Avoidance	.57	.63	.60
Support seeking	.84	.81	.83
Locus of Control	.48	.57	.53
Depression	.71	.74	.73
Marginalization	.63	.73	.69
Stress	.84	.80	.83

factors because of the considerable overlap in items, it may be noted that our factors are not completely identical with Amirkhan's.

Marginalization. The 14 items of the marginalization questionnaire were factor analyzed. As expected, a scree test showed a clear unifactorial structure; the eigenvalues of the first three factors were 2.90, 1.20, and 1.03. The factor loadings of the items were fairly homogenous, ranging from .32 to .63; the only exception was the item 'I want to be as happy as others are', which had a loading of .00.

Depression. The 20 items (question 21 'Presently I have less interest in sex than in the past' was deleted) of the Beck's Depression Inventory questionnaire were factor analyzed. A scree test suggested a unifactorial structure; the eigenvalues of the first three factors were 3.45, 1.61, and 1.25. A two-factorial solution showed some similarity to the findings of Shek (1990, 1991), who found an affective and a somatic depression component in a Chinese population. However, as many items showed secondary loadings and an oblique rotation would have been required with a substantial cross-factor correlation, it was decided to retain a single factor.

Stress. The stress questionnaire revealed an analogous pattern. A scree test pointed to the extraction of a single factor (eigenvalues: 4.74, 1.75, and 1.14). No item showed very low loadings (range: .26 to .60).

Locus of control. A factor analysis of the locus of control scale yielded less straightforward results. The expected three-factorial structure could not be retrieved. A scree test did not clearly favor a particular number of factors (first five eigenvalues: 2.43, 1.87, 1.42, 1.18, and 1.11). Also, the deviances of the expected structure of the three-factorial solution were numerous: less than half of the items showed their highest loadings on the target factor and many items showed secondary loadings. Apart from a one-factor solution (presumably reflecting locus of control), no solution containing more factors could be adequately interpreted. Therefore, it was decided to retain a single factor. It may be noted that problems with the interpretability of factor analyses in non-Western settings are common (cf. Dyal, 1984).

Table 1.3.4. Correlations of level of environmental degradation with other predictors

Predictor	Correlation
Status	-.49***
Education	-.05
Locus of control	-.19***
Avoidance (coping)	.25***
Problem solving (coping)	-.09*
Support seeking (coping)	-.04

* $p < .05$. *** $p < .001$.

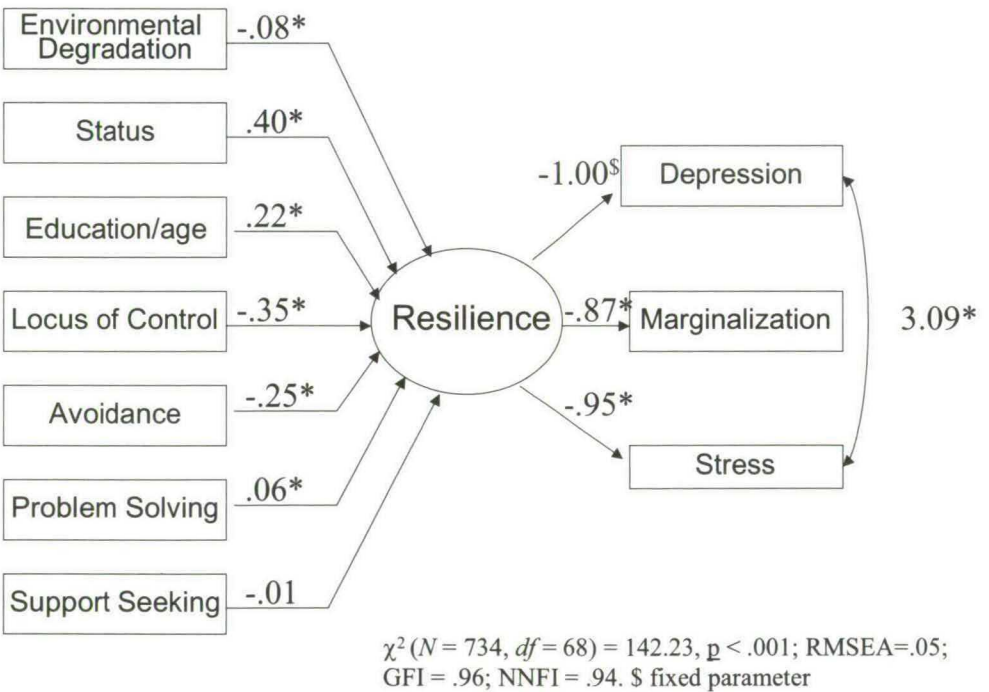


Figure 1.3.4. Estimated parameters of the MIMIC

MIMIC Model

The next stage of the data analysis attempted to model the consequences of environmental degradation in a structural equation model. The input variables were environmental degradation (three levels), status (factor scores), education/age (factor scores), locus of control and coping styles (sum scores of the scales). Output variables were depression, marginalization, and stress (summed scale scores). The input and output variables were related using a MIMIC model. The latent variable that links the input and output was labeled resilience. In line with previous studies in which we often found substantial gender differences, both in terms of score levels and correlations between scales (Van Haaften & Van de Vijver, 1996a, 1996b, 1998), separate MIMIC

Table 1.3.5. Estimated Effect sizes (Proportion of variance accounted for) of the Multivariate Analysis of Variance with Degree of Degradation (D) and Gender (G) as Independent Variables and Marginalization, Stress as Dependent Variables

Source	Multivariate ^a	Depression	Marginalization	Stress
D	.05***	.08***	.12***	.07***
G	.07***	.00	.00	.05***
D x G	.01	.00	.00	.01

^aWilks' Lambda. *** $p < .001$.

Table 1.3.6. Average Scores for Marginalization, Depression and Stress per Gender, and Level of Degradation

Degradation ^a	Marginalization		Depression		Stress	
	Females	Males	Females	Males	Females	Males
Quzhou	22.9	23.0	32.7	32.9	32.6	34.0
Mountain area	21.0	21.2	30.6	30.5	29.0	32.0
Industr. area	21.0	20.6	30.9	31.0	29.7	32.2

^aAreas are ordered from most to least degraded.

models were fitted for women and men. The present data set did not show these pronounced gender differences. A model with parameters constrained to be equal for both genders yielded an adequate fit, if the error terms of depression and stress were allowed to covary ($\chi^2(N = 734, df = 68) = 142.23, p < .001$; RMSEA = .05; GFI = .96; NNFI = .94). As can be seen in **Figure 1.3.4**, the three output measures (depression, marginalization, and stress) showed negative loadings, as could be expected. Furthermore, all predictors, with the exception of support seeking, showed significant relationships with resilience ($p < .05$). More specifically, a lower degree of environmental degradation was associated with more resilience. Individuals living in more degraded environments were in a poorer psychological state. A higher socioeconomic status was associated with more resilience. This is in line with our findings in Africa; status is presumably related to prosperity: richer persons have more material resources to deal with adversary conditions, such as environmental degradation. Education was positively related to resilience. Locus of control was negatively related to resilience, indicating that externally oriented individuals showed less resilience. Avoidance was negatively associated with resilience while problem solving was positively related.

The current pattern of findings largely replicates our findings in Africa, with the exception of support seeking that was unrelated to resilience in the present study while it showed a positive relationship in the African data.

It is interesting to study the correlations of environmental degradation with the other predictors in more detail. The correlations, reported in **Table 1.3.4**, are based on scores that are standardized per gender in order to avoid the confounding influence of gender differences. A strong correlation of $-.49$ ($p < .001$) was found between degradation and status; individuals in the least degraded regions are on average better off than those in the more degraded regions. Education was unrelated to degradation ($r = -.05, ns$).

Individuals living in more degraded regions tended to show a more externally oriented locus of control ($r = -.19, p < .001$), more avoidance ($r = .25, p < .001$), and less problem solving ($r = -.19, p < .05$). Support seeking did not show a significant correlation. The pattern of findings seems to suggest that environmental degradation has various negative psychological concomitants.

It should be noted that the design of the present study does not allow for simple causal statements about the relationship between environmental degradation and psychological consequences. Three different kinds of causal relationships can be envisaged. First, environmental degradation may induce negative psychological consequences. Second, low levels of the psychological resources (such as coping) and high levels of stress, depression, and marginalization which, in turn, could lead to a passive attitude vis-à-vis the environment and could trigger environmental degradation. A third possibility would be that degradation and psychological resources are involved in feedback loops (in line with **Figure 1.3.2**).

Analysis of Variance

A final analysis addressed the size of regional and gender differences in the outcome variables (i.e., depression, marginalization, and stress). These differences were examined in a multivariate analysis of variance with region (representing three levels of degradation) and gender (two levels) as independent variables and the three MIMIC output variables as dependent variables. Proportions of variance accounted for by the factors are presented in **Table 1.3.5** and the averages per region and gender in **Table 1.3.6**. Region showed significant differences for each dependent variable (all $ps < .001$), with effect sizes ranging from .07 to .12. As can be seen in **Table 1.3.6**, the differences in means are mainly due to the relatively high scores on each dependent variable in Quzhou, the most degraded region. Gender differences were nonsignificant for depression and marginalization, while stress was significantly higher among men than among women (5% explained, $p < .001$).

Discussion

The current study addressed the question to what extent environmental degradation and human resilience are related in China. Our previous studies in Africa have demonstrated that high levels of environmental degradation tend to be associated with high levels of psychological distress. The current study is a generalizability study (van de Vijver & Leung, 1997, 2000) that extends these findings to China. In line with these results in Africa and with the ecocultural model of **Figure 1.3.1**, ecological influences (environmental degradation) and psychological process variables, such as coping and locus of control, were found to be related to resilience in areas of severe environmental degradation. More specifically, a good fit was found for a MIMIC model, postulating a relationship between eight input variables (environmental degradation, status, education/age, locus of control, avoidance, problem solving and support seeking) and

three output variables (depression, marginalization, and stress). Avoidance was the process variable with the strongest relationship with human resilience, while marginalization was the output variable with the strongest relationship.

The correspondence between the findings of the current study and the studies in Africa is remarkable, given the massive differences in ecological conditions (desertification and a degrading rain forest in Africa versus salinization in China) and cultural backgrounds of the participants. All studies have dealt with levels of degradation that are so high as to be threatening to local farmers. We consistently find a positive relationship between environmental degradation and psychological distress, which clearly supports the notion that environmental degradation has psychological concomitants. Furthermore, a more external locus of control and more avoidance are always accompanied by more distress. The low internal consistency, the absence of an easily interpretable factor structure of the locus of control scale, and its significant relationship with resilience are also remarkably consistent across our studies.

A disadvantage of many generalizability studies is their typically low level of attention for culture-specific conditions and measures (Van de Vijver & Leung, 1997, 2000). This argument could also be leveled against the present study. It could be argued that our minor adaptations of the measures do not yet ensure their adequacy in a Chinese context. However, it is clear that there is a trade-off between maximizing cultural suitability of measures and maintaining high levels of equivalence across cultures. If our measures would have yielded factors that were not observed before or the MIMIC model would not have shown a good fit, we would have needed to identify the source of the problem (poor measures and/or incorrect model). However, given the high level of replicability of the findings in Africa, we feel confident that the model and measures are adequate for the Chinese context. Locally developed measures may have shown a more refined picture. However, it is unlikely in our view that entirely different relationships between the variables of the MIMIC model would have been found, if the questionnaires had been locally developed.

The present study has implications for the management of natural resources. Particularly in areas with high levels of environmental degradation it is important to take psychological factors into account. Farmers with high levels of psychological distress due to high levels of environmental degradation are unlikely to display behaviors that stop or reverse the degradation process. However, the cooperation of farmers is needed in maintaining and restoring damaged ecosystems. It is a major task for the management of natural resources to reconcile the short-term needs of farmers that may further deplete environmental resources, with the long-term need to restore an environment with sufficient biodiversity. Sustainable development is a real challenge in many countries. Psychological expertise is an important aspect of this management.

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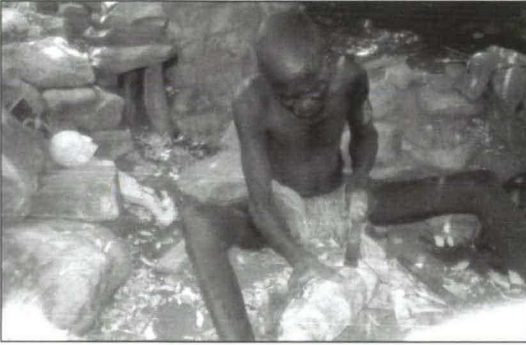
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Section 2

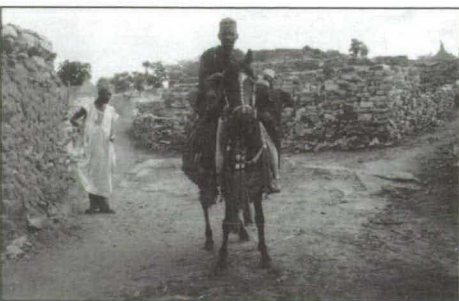
Interdisciplinary approaches:
Towards understanding sustainability
by integration of psychology and physical sciences



Forgeron of Segue



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Griot of Segue

Chapter 2.1

Management of Natural Resources and the Possibilities of Disciplinary Perception and Interdisciplinary Communication

E. Heleen van Haaften (2000)

Management of natural resources and the possibilities
of disciplinary perception and interdisciplinary communication. *The Land*, 4.1, 45-60.

Abstract

Interdisciplinarity and especially interdisciplinary communication seems to be a vital condition for effective application of science in achieving sustainable production of goods and services. Sustainable agricultural production is no exception and the problems in the agricultural sector are complex and can only be resolved through interdisciplinary cooperation. The model, used to explain and approach interdisciplinary problems of sustainability is shortly discussed.

These universal problems are the subject of this article. They are discussed in the context of sustainable agricultural production.

The actors involved (researchers, managers, farmers, etc.) are addressed on an individual level as far as disciplinary backgrounds and the consequences for their actual behavior are concerned. The influence of paradigms, scientific methodologies, attitudes towards nature and scales of time and space are discussed to explain disciplinary differences in perception of environmental degradation. We mention the same topics at group level. Experiences in interdisciplinary teams appear to be similar to experiences in groups dealing with intercultural communication. Like groups of different cultural background, members of scientific disciplines deviate in perception according to their degree of 'relatedness' and the different types of interdisciplinarity are mentioned. Concluding interdisciplinarity at societal level is mentioned. In the western world scientific knowledge is organized within institutions, which often reinforce disciplinarity and discourage the development of interdisciplinary communication.

We demonstrate the possibilities with an interdisciplinary study of resilience of humans as well as land.

Introduction

Since the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, it is (again) recognized worldwide that problems related to sustainable production are complex and can only be resolved through interdisciplinary cooperation. At the global scale, more than 1 billion people live in absolute poverty, and 800 million do not get enough food to eat. Each year 5 to 10 million hectares of land are lost to severe environmental degradation (IFPRI-Report 1999). These figures are well known to those concerned about worldwide poverty and environmental damage, but what do they mean for the individuals affected? What are the root causes of these problems, and what can be done to solve them?

To find answers to those questions, large interdisciplinary research projects were started; many of them with a focus on sustainable management of natural resources. These and earlier experiences showed that interdisciplinary research is difficult to implement and also that the application of the results posed more problems than were foreseen.

Problems related to interdisciplinarity are experienced in any project where disciplines work together to achieve sustainability. These universal problems are the subject of this paper. They are discussed in the context of sustainable management of natural resources.

Three Groups of sciences Perceive sustainable management of Natural Resources:

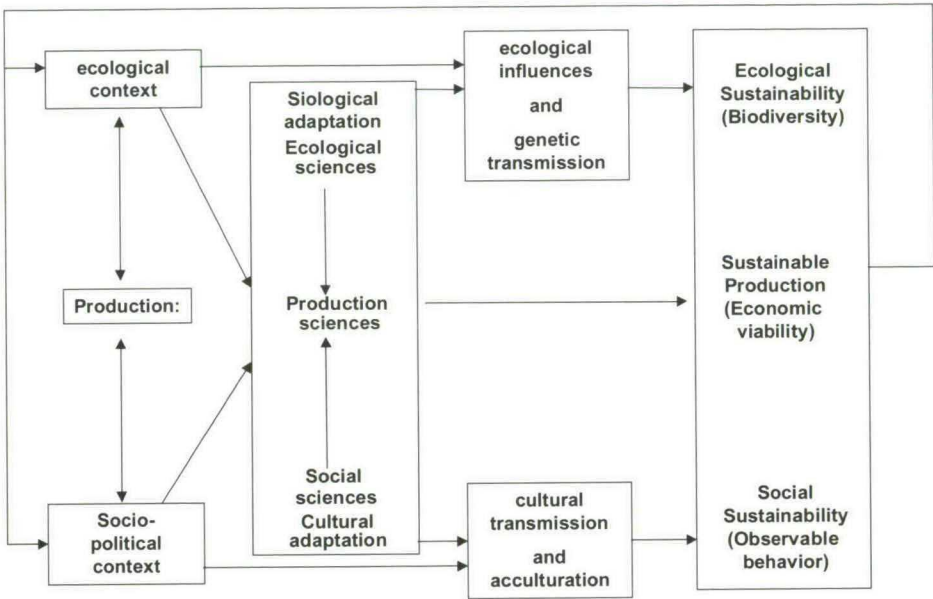


Figure 2.1.1. The ecocultural model: three groups of sciences (ecology, production, social) perceive sustainable production in different ways (adapted from Berry et al. ,1998)

The model (Figure 2.1.1) used to grasp the interdisciplinary dynamics of sustainability is the ecocultural model as developed by cross-cultural psychologists (Berry et al., 1988). They suppose that individual behavior can only be understood when both cultural and biological features of our species are taken into account. The flow of the figure is from population level variables, influencing the individual outcomes. This connects with the point of view of cross-cultural psychologists that individual and group differences in psychological characteristics are a function of population level factors. So, it might be that farmers display individual behavior, due to pressures at community level, like the pressures currently coming from eco-activists to use agro-industry resources more sustainably.

The ecological context (Figure 2.1.1) is the setting in which human organisms and the physical environment interact. To understand the psychological outcomes at the individual level, we need to study a system where:

- the ecological context and the socio-political context function as background variables;
- ecological influences (studied by ecological scientists) and genetic transmission function as process variables by which a degree of biological adaptation is achieved;
- cultural transmission and acculturation function as process variables to bring about

cultural adaptation and are studied by the social scientists; and.

- observable behavior at the individual level and inferred characteristics are displayed as psychological outcomes, studied by psychologists.

A third group of scientists – in the production sciences – study the most rational way humans exploit natural systems for their own needs. They can be considered as operating at the interface between nature and culture. In an era of substantial technological change, with the consequent cultural changes that this brings, almost all communities are in the process of rapid change, with high risks for ecological and social sustainability, which are essential for sustainable production.

The existence of different perspectives for assessing the sustainability of agricultural development has been pointed out by several authors (e.g., Giampietro, 1997). In spite of minor differences in definition, there seems to be agreement that at least three fundamental perspectives should be considered:

- The ecological view: agricultural techniques must be environmentally sound;
- The production view: agricultural techniques must be economically viable;
- The social view: agricultural techniques must be acceptable to farmers and society, given their culture, ethics, and religion.

Integration of the three kinds of sustainability seems to be necessary for the future of the human race. This integration creates a need for interdisciplinary communication among widely differing groups of stakeholders which has been the subject of study already for several decades and seems to give the same problems as intercultural communication.

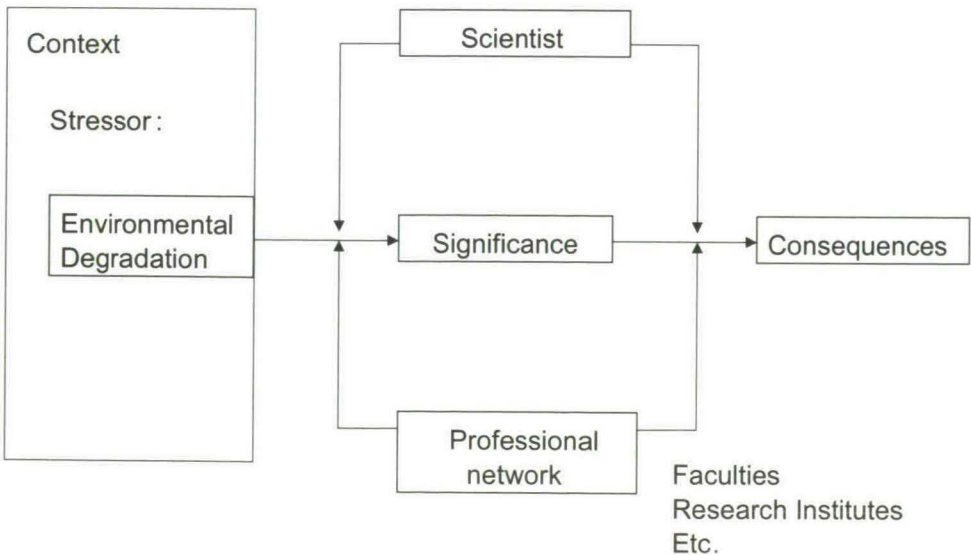


Figure 2.1.2. Perception scheme for professional disciplines affected by paradigms, methodologies, Scales of time and space, and attitudes towards nature

Scientific perception

Differences in professional perception of scientists (**Figure 2.1.2**) are reflected in paradigms, the methodology of their discipline, their scientific attitudes towards nature, and the scale and time dimensions of their discipline.

To understand the perception scheme (**Figure 2.1.2**) it is supposed that within a particular context, which can be defined as a village or region, a profound change occurs, like salinization, or more general environmental degradation, that causes upheaval within the community. This change is called a stressor. This stressor has a significance that is experienced by all of the people who have to cope with it, like farmers, members of landcare groups, as well as the soil scientists, agronomists and social scientists.

This experience, or the way the change is perceived, is different for each individual, for each social group, and thus for each scientific group. Those differences in perception can be analyzed on an individual level and at group level. Remarks in this paper are confined to the individual level.

How the professional network influences the perception of the individual scientists (**Figure 2.1.2**) is described by the anthropologist Mary Douglas (Douglas, 1987) among others. Although important, it will not be considered further in this article other than to remark that the disciplinary way in which western society has organized its institutions makes it very difficult to achieve adequate change.

Actual and observable behavior is a reflection of the consequences of any changes in a production system (**Figure 2.1.2**) and mirrors the significance of the stressor as sensed by the perceiver.

Each of the elements involved in professional perception are now examined in more detail.

Paradigms

Paradigms are a set of beliefs that deal with ultimate or first principles of any particular science and thus represent a worldview, defining the nature of the world as seen by that professional group. Consequently it represents a mental map as it represents also the individual's place in it. Such worldviews are products of learning and experience. Each scientific discipline has started by formulating special paradigms.

Disciplinary methodologies

Scientific practice is highly dependent on disciplinary methodologies. In fact, the methodology determines the discipline and is the heart of disciplinary identity.

A philosophy of science also takes in its history. Systems of meanings and relations make 'things' reasonable and plausible, sometimes leading to conflicts that linger on for a long time.

Professionals know the methodologies within the discipline, as the quality of professional education is often judged by the methodological skills of the practitioners.

How to change the discipline and how to connect it to ‘real life’ developments or other disciplines is less known and often resisted. Reasons for that lack of knowledge can be called ‘cultural’, and they show the same psychological resistance mechanisms as cultural change.

Scales of time and space

Di Castri et al. (1986) illustrated the large differences in scale with respect to time and space for the different disciplines in the following figure (Figure 2.1.3). The target groups for an anthropologist, like communities and villages, or the target group of the sociologists, like a sugar mill area, are quite different from those of a hydrologist (a watershed for instance) or a soil scientist (a cross profile). This might cause a ‘scale of space problem’. Time references for a forester often span fifty to hundred years, while for an anthropologist, the scale of time is connected to the concerns of the groups they study and can differ from a few days to several years.

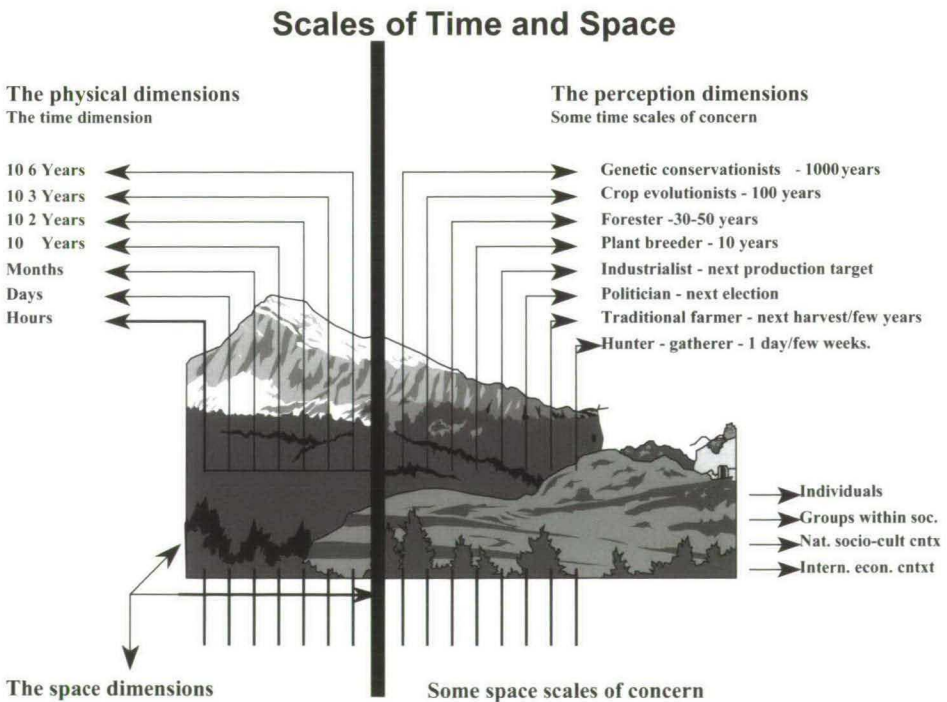


Figure 2.1.3. Scales of time and place.

Attitudes towards nature

People reflect their opinion about reality in their attitudes towards nature. Theories about the relationship between humans and their environment can be derived from natural or physical sciences (ecology, physics etc.) or from social and behavioral sciences

(e.g. economics). In the social sciences, there is the everlasting discussion of man as a part of nature versus man and culture against nature (e.g. nature-nurture discussion in psychology). It seems like:

“Man inhabits two worlds. One is the natural world of plants and animals, of soils and airs and waters which preceded him by billions of years and of which he is a part. The other is the world of social institutions and artifacts he builds for himself, using his tools and engines, his science and his dreams to fashion an environment obedient to human purpose and direction.”

In a study from Dunlap and van Liere (Arcuracy, 1990) attitude toward nature was subdivided into (a) balance with nature; (b) limits to growth; and (c) humans over nature.

The idea of nature as a function of social organization, and the way individuals are caught up within systems of knowledge, are things that are too complex to be taken into account in this study of attitudes, but should be an important aspect for further research.

The philosopher Zweers defined 6 different attitudes towards nature (Zweers, 1995). In research associated with a large interdisciplinary project in Cameroon, the categorisation of Zweers was used to see if there were disciplinary differences in attitudes towards nature (van Haaften and Henrison, 1996). The categories that were used were: **Man as despot.** Man as an absolute governor who modifies the environment to his need, without any consideration.

Man as enlightened governor. Man governs nature but is conscious of the dependability on nature, the limits of its resources, and the resilience of ecosystems.

Man as steward. Man manages or governs in the name of somebody else. He is accountable to a supernatural authority or to society, including the next generations.

Man as partner of nature. The image of partner makes this option quite different from the preceding concepts, because one works with a partner on the basis of equivalence to attain a common goal.

Man as participant of nature. It belongs to the specific human capacities to be part of nature in his own way, by recognising the value and experiencing the meaning.

‘Unio Mystica’. This concept is directed towards religiosity and identification (‘Oneness with nature’). One can not talk about it in a reflective way.

The categories of Zweers were used to interrogate if there were significant differences between attitudes of the stakeholders and scientists. With a factor analysis, two factors could be determined (**Figure 2.1.4**), which were called the ‘relative care for nature’ and the ‘relative distance of nature’.

In this study, it appeared that the three direct users of forest resources, the Bantu farmers, the Pygmy nomads, and the commercial loggers were considered to exhibit the least distance to nature. Their relative despotism however was judged completely differently. Loggers were seen as the most despotic group without any consideration,

Types of Interdisciplinarity.

A) Narrow Interdisciplinarity

B) Broad Interdisciplinarity

1. Interaction between Disciplines with:

- Same Paradigms
- Same Attitudes towards Nature
- Same Methods

*Easy Integration Disciplinary
Outputs.*

- Different Paradigms
- Different Attitudes towards Nature
- Different Methods

*Difficult Integration Disciplinary
Outputs.*

2. Amount Disciplines involved

Few

Simplifies communication

Many

Complicates communication

3) Representatives of Disciplines Located in

Same Organization

*Simplifies communication and
organization*

Different Organizations

*Complicates communication
and organization*

4) Representatives of Disciplines from the

Same Culture.

Simplifies communication

Different Cultures.

Complicates communication

Figure 2.1.5. Types of Interdisciplinarity

while the nomads (Bagieli) were considered as the most participating group. It should be noted that this concerns the images the interviewees have.

Interestingly, groups of scientists seem to repeat the pattern of the users of forest resources: the ecologists were considered to exhibit the least despotism and the forest scientists the most. These findings are important for interdisciplinary communication. Those biases can seriously upset free scientific communication. Team management has to acknowledge these biases and to facilitate communication.

These findings are relevant in three respects. In the first place, attitudes towards nature express the idea of reality. In the second place, it is possible that those attitudes are the source, or largely the source, of the interdisciplinary communication problem and, in the third place, the different attitudes can block scientific communication.

Types of interdisciplinarity

Just as it is possible to communicate between cultures, it is possible to communicate between disciplines. Disciplinary diversity and interdisciplinarity are not opposites, but complementary aspects of science.

Interdisciplinary communication is facilitated by:
Consciousness of one’s own discipline (emic) in relation to universal phenomena (etic).
The need for solutions to problems that can’t be solved with contributions from one discipline.

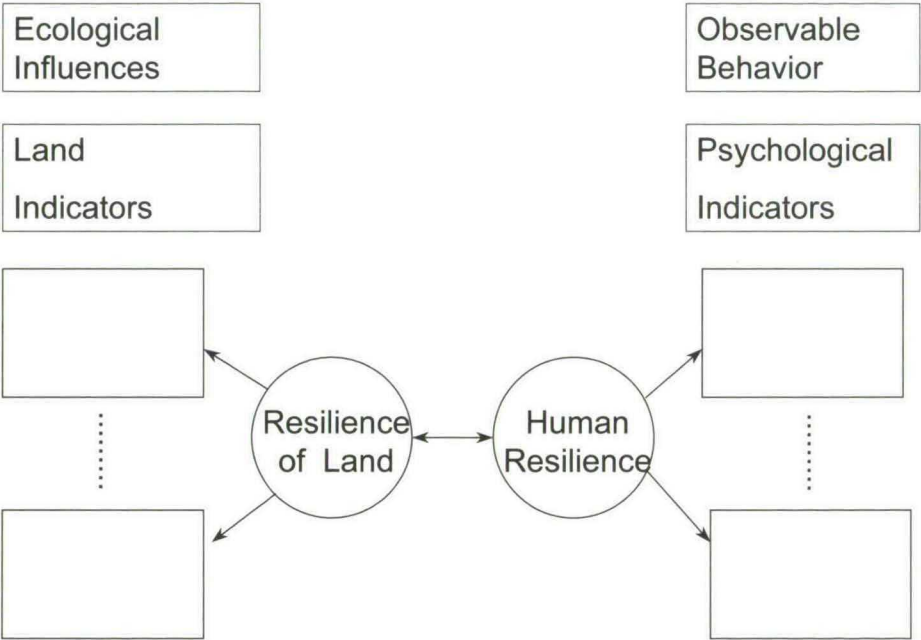


Figure 2.1.6. The reduced model

It is possible to distinguish between several types of interdisciplinary research (Figure 2.1.5). This distinction is useful because there are considerable differences in the constraints one encounters during the preparation and implementation of the different types of interdisciplinary research (Van Dusseldorp & Wigboldus, 1998).

In short, the figure illustrates that starting with a team consisting of a small number of members from the same organisation who are closely related and with the same culture, problems of communication and organization will continuously increase and will culminate in large interdisciplinary teams with representatives from disciplines that have little in common and with different organizational and cultural backgrounds.

In interdisciplinary research for integrated rural development and sustainable use of natural resources, the most complicated mode of interdisciplinary research *always* applies. Because in this case, broad interdisciplinarity is required, a large team is needed, and researchers and their counterparts come from different organizations and cultures. But this type of approach leads to new research opportunities that couldn't be met before.

The working definition of interdisciplinary research can best be described as a methodology to investigate complex problems by a team of researchers from various disciplines. While working in their own disciplines, team members are trying to achieve the main objective of the research by communicating with each other and using results from others.

The complexity of the ecological, social-economic, and cultural environment in which resource utilisation problems have to be solved is a typical case requiring interdisciplinary research. For example, land use problems and access to natural resources in developing countries are infrequently solved by agricultural research alone. The factors causing the process of land degradation are, in this era, mainly related to human needs and social-economic constraints.

An example

In a large interdisciplinary project in the Sahel the soil scientists and the psychologist decided to study two different parts of the ecocultural model as illustrated in **Figure 2.1.1**. The soil scientists formulated the ecological influences and the psychologist the behavioral outcomes. They redefined the model in terms of sustainability that led to the sub-model in **Figure 2.1.6**.

While this research was conducted in a farming system that was operating at a subsistence level, it is believed many of the same principles apply in commercial scale farming.

Conclusion

The human use of natural resources operates on the interface of two complex systems: human societies and ecosystems (**Figure 2.1.1**). Results like those briefly described above come from a range of interdisciplinary efforts and have implications for participative approaches to the management of natural resources in two ways.

First, low levels of resilience can lower the motivation to invest effort in environmental change and to prohibit adequate communication: highly stressed and marginalised groups may well become inert and may cease to display coping behavior (which in many cases has been fruitlessly applied in the past). For governments and, for instance, extension services, it could become very difficult to keep in touch with psychologically marginalised individuals because they often no longer see any use in being part of a group. They seem to draw back from social life in a fundamental way.

Second, groups experiencing high levels of stress and marginalisation will be psychologically vulnerable and susceptible to various psychological problems such as depression.

Participative management may be impossible to achieve among groups with little resilience. Neglecting the relevance of psychological factors may well lead to ineffective management of natural resources and to avoidable conflicts between government and the local population. Communication problems created by high stress and marginalisa-

tion levels will be hard to overcome, even with more active involvement of the local population in the management of natural resources. High levels of degradation will have various social implications which can easily become psychologically more important than the degrading environment such as the need to generate income. In addition, they challenge the traditional roles in society, and lead to a dim future perspective.

Environmental degradation, and its psychological aspects, form an enduring process with mutual feedback loops. An environment that starts to degrade, physically, economically and socially will induce psychological consequences. These, in turn, can lead to behavior that will accelerate degradation. Strong feelings of marginalisation can give rise to migration and to more rapid degradation of the environment. However, the onset of degradation may also lead to behavior that will effectively cope with the threat of a loss of natural resources. The choice of coping strategy has implications for effective management. Unfortunately, we do not have much insight into the determinants of the choice or in the dynamics of the psychological aspects involved in degradation processes. Additional research on the rate and nature of degradation and additional social research on the differences in stress and marginalisation between cultural groups is necessary.

It could be conjectured that the role of psychological stress and marginalisation levels in sustainable management of natural resources follows a threshold model: mild or moderate levels will hardly influence communication. However, beyond a threshold level, these processes prohibit efficient communication altogether. Future research will be needed to specify the critical threshold values and to define social and psychological indicators that are related to these high stress and marginalisation levels. Management should adopt wholly different approaches below and above the threshold in order to be effective.

Ecological, social and production sciences look differently at changes induced by production science. In spite of their differences, integration of their perspectives is required to obtain sustainable production. Differences in disciplinary perceptions and attitudes towards nature between disciplinary groups are considered to be important stress factors affecting natural resource management. Consensus on criteria and indicators for sustainable management seem to be necessary to develop new feed back systems on sustainable management.

It can be concluded that after acknowledging the communication problems and providing possible solutions and skills to resolve them, the real objective i.e. sustainable use of natural resources may have a chance. This may involve a reorientation of the various disciplines towards their own paradigms.

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Chapter 2.2

Human and Biophysical Carrying Capacity in a Degrading Environment: The case of the Fulani in the Sahel

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Human and biophysical carrying capacity in a degrading
environment: The case of the Fulani in the Sahel. *The
Land* 2(1), 39-54.

Summary

The concept of carrying capacity has strong interdisciplinary aspects. The central issue of this study of the Fulani pastoralists in the Sahel is the relationship between psychological and biophysical carrying capacity.

Three contrasting regions were assessed in terms of vegetation cover, erosion, and loss of organic matter. The indicators of psychological carrying capacity were psychological stress and marginalisation.

A structural equation model of the relationship between psychological and biophysical indicators was fitted to the data. A good fit was found for a model in which both the biophysical and the psychological indicators define their own underlying latent variable. 88% of the variance of the psychological latent variable 'human carrying capacity' was explained by the biophysical latent variable 'carrying capacity of land'. A multivariate analysis was carried out, with gender and region as independent variables and stress and marginalisation as dependent variables. Individuals in more degraded regions reported more stress and marginalisation. Men scored higher on marginalisation and lower on stress than women.

The data point to a close link between biophysical and psychological indicators, thereby underlining the fruitfulness of an interdisciplinary approach to carrying capacity. The results also have implications for participative approaches to the management of land.

KEY WORDS: physiological carrying capacity of land, soil degradation, vegetation cover, psychological carrying capacity of humans, psychological stress, marginalisation, gender, Fulani, Sahel

Introduction

We are all more and more aware of the needs of growing human populations and related concerns for the integrity of the environment and cultural continuity. It is indisputable that environmental degradation has usually followed pressure on scarce natural resources. It is also argued that the physical environment is a crucial context of human behaviour (Berry et al. 1997). Severe environmental degradation may result in the complete loss of primary resources and of food and income of local populations. As a consequence, environmental degradation has both biophysical and psychological consequences. It is remarkable that even though, in many developing countries, environmental degradation is a serious problem with different impacts on different cultural groups, its psychological aspects have received scant attention. The tendency towards participative management of natural resources (e.g. Pretty 1997, Dent 1997) seems mainly concerned with degrading environments. However, degradation processes trigger reactions amongst people, such as apathy and marginalisation.

Here we examine individual differences in psychological reactions to environmental degradation and argue that psychological carrying capacity and carrying capacity of land are essential concepts to understand these reactions.

The model

Previous work

The model used (Figure 2.2.1) was tested first among inhabitants of two rapidly degrading rain forests in the Ivory Coast. Stress and marginalisation among the Agni and Niaboua, two cultural groups that are highly dependent of those forests, were found to be positively related with the degree of degradation of the rain forest (van Haaften and van de Vijver 1996a).

In another study, psychological aspects of environmental degradation were examined among two groups of Sahel dwellers: the Mossi and the Fulani nomadic pastoralists (van Haaften and van de Vijver 1996b). Agriculturists turned out to be more stressed and marginalised than pastoralists. Men in both groups scored higher on marginalisation and lower on stress than women.

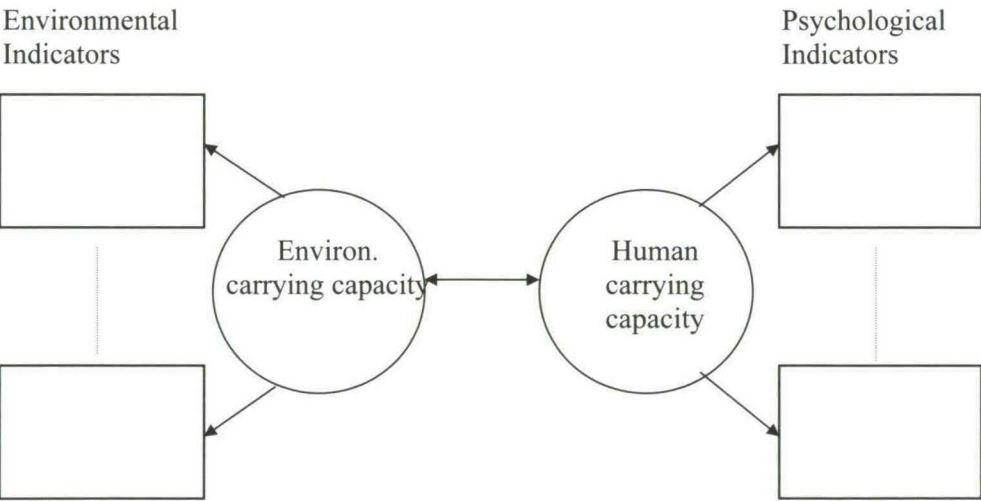


Figure 2.2.1. Outline of the model structure used

A structural equation model was fitted to the data. The model postulated a causal relationship between four input variables (culture, environmental degradation, cattle, and modernity); a latent variable (called carrying capacity); and two output variables (stress and marginalisation). Modern attitudes and an external locus of control were associated with less carrying capacity and, hence, with more stress and marginalisation. Coping style and status in the community were unrelated to carrying capacity.

It was also found that individuals living in a less degraded, though rapidly degrading, environment showed a lower carrying capacity. This finding points to an ambiguity in our studies about the influence of environment degradation on human carrying capacity: individuals may react both to the state of degradation (e.g. to a shortage

of nutrients in the soil, absence of vegetation); or to its rate (i.e. to the change in available nutrients, vegetation cover, and so on). The present study is an elaboration of van Haaften and van de Vijver (1996b). The sample size is three times larger and the study has been extended to the Dogon area. The results presented here are limited to the Fulani, because they are the only group who live in all three areas of study.

Psychological carrying capacity

The concept of carrying capacity is often applied in systems theory to describe the resilience of a system that has to cope with a substantial increase of the load to be carried. Excessive pressure on the land can lead to breakdown of the system. Psychological carrying capacity is used here as a generic name for people's flexibility to deal with sudden and substantial increments to the carried load - in particular to environmental and cultural changes. It is determined by a complex set of cultural and psychological variables, and cultural groups differ in their response and relative success in dealing with these changes. Cultural legacies shape the processes of coping: norms and values but also symbols and rituals channel thoughts and emotions and, consequently, create opportunities for adjustment (Kleber et al. 1995). In a way, psychological carrying capacity is an indicator of the effectiveness of these tools. If existing tools are inadequate to deal with pressing problems, psychological carrying capacity is diminished. There are no direct ways to measure psychological carrying capacity although there is a good deal of theory.

Psychological stress

Moderate levels of stress can have positive effects on human behaviour. Mild stressors incite individuals to take appropriate action. However, if changes in the natural and human environment, such as environmental degradation, become threatening, they often cause high levels of stress (Blaikie & Brookfield, 1987). Likewise, processes of acculturation (changes in an individual who is exposed to a new culture as a result of rapid cultural change or migration) can lead to sharply increased stress. Prolonged exposure to high levels of acculturative stress induces illness, burnout, depression, and aggression (Berry et al., 1988).

Only few studies have examined the psychological effects of a marked loss (or threat of loss) of essential elements of daily life. Carry and Weston (1978) studied reactions of agriculturists in Australia to a sudden and marked drop in income between 1973 and 1976. Agriculturists experienced considerably more stress and hostility than (a control group of) non-agriculturists. Individual differences in stress could not be fully explained by differences in income. Rather, high stress levels were present among agriculturists who felt unable to meet the expectations of themselves or persons in their neighbourhood.

Lumsden (1975) examined the psychological consequences of the construction of the Akosombo Dam and the creation of Lake Volta in Ghana. About 80 000 people were resettled to 52 new villages. These people had to deal with various stressors, such as loss of jobs, leaving the land of their ancestors, moving to new and smaller houses,

being forced to mix with other cultural groups, and facing hostility from these groups. Lumsden found that, after resettlement, there was an increase in suicide, alcoholism, provocative manslaughter, and witchcraft - all indicators that a group is under severe stress (Naroll, 1970).

Psychological marginalisation

Berry et al. (1997) define four types of attitudes adopted by people exposed to a new culture as a result of rapid cultural change or migration: integration, separation, assimilation, and marginalisation (see Figure 2.2.2).

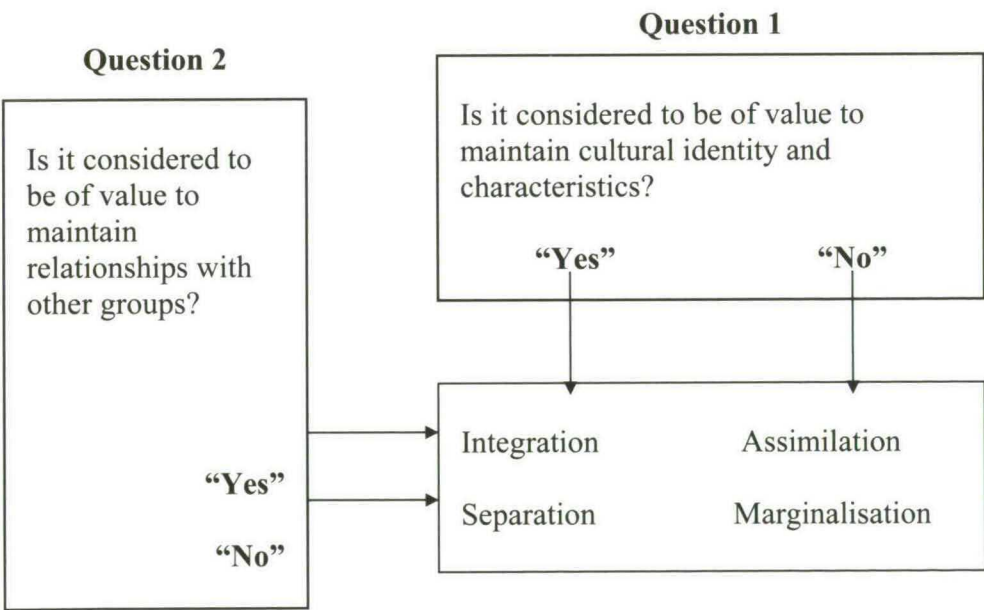


Figure 2.2.2. Four modes of acculturation as a function of two issues
(H. Berry et al., 1992) (Berry et al. 1997)

Combining two questions with yes-no responses identifies the four types. The first question considers the relationship with the original culture: does the individual who is acculturating want or is the individual able to retain positive attitudes towards his or her original culture? The second question considers the same issue in relation to the new culture. Integration is the acculturation style in which positive attitudes towards both the old and new culture are sought. It is often associated with a bicultural identity; elements of both cultures are combined in the attitudes and behaviour of the acculturating individual. Separation means that the old way of life is maintained, with only superficial contact with the new culture. Individuals who opt for assimilation, establish good relationships and show a positive attitude towards the new culture while the ties

with the original culture are lost; they abandon their traditional way of life and fully adapt to the new culture. Finally, marginalisation is the acculturation style in which positive relationships with neither culture are sought. The old way of life is rejected and the new culture is not considered to constitute a viable alternative.

Marginalisation amounts to culture loss. This can occur in the context of rapid cultural change when new and serious challenges have to be met, such as environmental degradation or the breakdown of social institutions. Neither the old culture nor the new, often Western, culture is seen as providing the tools to adequately cope with the problems of daily life. In its extreme form, marginalisation can lead to severe social disruption. Women, children, old people or the sick are often ignored by their relatives or by the community in highly marginalised groups. Particular groups are denied access to vital resources by other more powerful groups. Marginalisation can even threaten the very existence of a cultural group.

Stress, inner conflict and insecurity accompany all four acculturation attitudes: integration has been found to constitute the least stressful option, followed by assimilation and separation. Marginalisation does not mitigate acculturative stress and can result in lifelong conflict (De Bruijn & Van Dijk, 1995). Stress and marginalisation constitute important psychological variables in effective natural resources management. It is unlikely that individuals will participate in management programs when subject to high levels of stress and marginalisation.

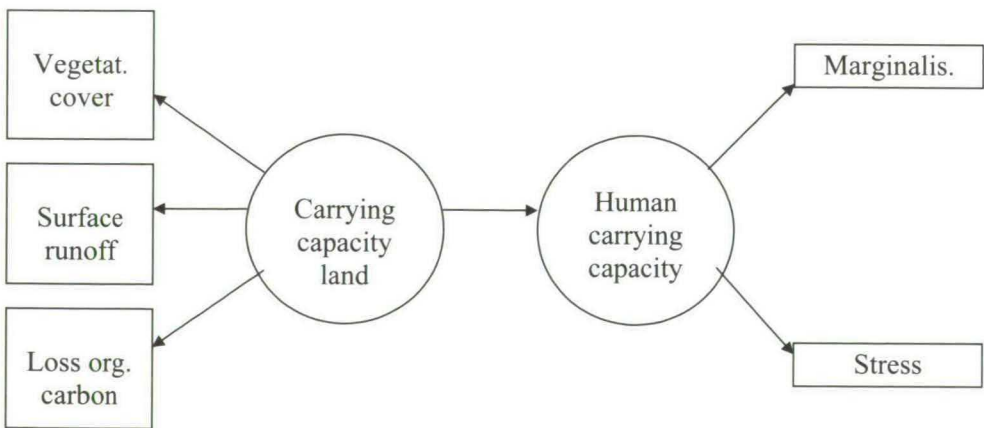


Figure 2.2.3. Model outline

Combination of carrying capacity of the land and psychological carrying capacity

Figure 2.2.3 presents a simplified model of the relationship between biophysical carrying capacity of the land and psychological carrying capacity which we have investigated in relation to the Fulani people in three regions with different rates and states of degradation. The design of the study is based on a crossing of gender and degree of environmental degradation.

Psychological carrying capacity

The Fulani

Fulani are pastoral in the sense that their lives and social organisation are dominated by the needs of their herds. Their social structure was originally egalitarian, in marked contrast to that of other Muslim groups, but the influence of Islam on kinship patterns is evident in the general preference for cousin and other intralineage marriages. Most men are polygamous, the typical household comprising the family head, his wives and unmarried children. Fulani women have their own cattle and are entitled to income from the milk and derived products of the whole herd.

The Fulani are dispersed within the kingdom of the Mossi and the area of the Dogon and are organised in wuro (settlements) that may or may not be attached to a Mossi or Dogon village (Riesman, 1974). In the case of conflicts over crops or cattle, a Fulani chief (Jooro) negotiates with the Mossi or Dogon authorities but, in general, Fulani men negotiate individually with Mossi and Dogon farmers. The former symbiosis between agriculturists (Mossi and Dogon) and pastoralists (Fulani) has gradually become under pressure as a result of population growth and related pressure on the land (Lekanne dit Deprez, 1995).

The locations

Three areas of research were chosen with different levels of natural resources: the Dogon region in Mali, and the Kaya and the Manga regions in Burkina Faso. Environmental degradation is strongest in the Dogon and Kaya regions where it already led to migration of agriculturalists. In the two Dogon regions and the Kaya region, temporary migration of 'Les Jeunes' (i.e. young men between 18 and 45 years) is more and more needed to support their families. Migration is widely experienced as a threat because of the loss of manpower and the danger that the young men might return with AIDS.

Interviews

Interviews were carried out in the Dogon area around Bandiagara in 10 villages and around Segue in 5 villages. In the region of Kaya, 6 villages participated. In the region of Manga where pressure on natural resources is less severe and there is an influx of agriculturalists and pastoralists from regions of more severe land degradation, interviews were held in 8 villages.

Sampling of respondents was done in consultation with village chiefs and Burkina Bé resource persons. In most cases, more than half of the inhabitants of a village were interviewed. In other cases, the chosen living areas were considered representative of the whole village. In total, 844 Fulani (394 women, 450 men) were interviewed: 236 from the Dogon area, 271 in the Kaya area, and 337 in the Manga area, all of them Moslem.

The vast majority (800) of the persons interviewed declared to be illiterate and had no or little education.

Marginality was measured with Mann's (1958) 14-item scale. A short 20-item version of the general symptom checklist SCL-90 (Derogatis 1977) was used to assess stress. The English questionnaire was translated via French into the languages of the cultural groups.

A four-day training course was given to the Mossi, Dogon, and Fulani interpreters. Respondents were nearly always interviewed by interpreters from their own cultural group. Interviewer and interviewee were always of the same gender.

Biophysical carrying capacity of the land

Principles

Indicators of land degradation were used to assess the biophysical carrying capacity of the land. Independent processes of land degradation were defined and quantified, and the rates of change were calculated for selected Village Systems. Control or reference Village Systems not subject to land degradation were defined first. A Village System is defined as an aggregation of spatially diversified land use systems, each a combination of land and land use (Driessen and Konijn 1992).

All Village Systems grew sorghum. Management packages were defined with fixed sets of activities except for sowing date, which varied according to climatic zonation.

The impact on production and, therefore, carrying capacity of weather variability over 33 consecutive years (1960-1992) was simulated using daily weather data from Dori and Ouagadougou which are representative of the Dogon and Zoundevogo areas. The Sanmatenga area occupies an intermediate position. This simulation also required information on the soils.

Soil units were distinguished by interpreting the digitised soil map of the world (FAO 1991) which has a resolution of about 10 km² at the latitudes concerned and indicates the relative frequencies of occurrence of soil types in a mapping unit. As not all soil information required was available, production potentials were calculated using the following default parameter values:

- Hydrologic soil characteristics are defined for soil texture classes as suggested by Driessen and Konijn (1991);
- Water infiltration characteristics were adapted, if necessary, using data from Hoogmoed and Stroosnijder (1996), Penning de Vries and Djitèye (1991) and Casenove and Valentin (1989);
- Soil depths and surface water storage capacities were estimated;
- Soil fertility characteristics were estimated from values tested by Leenaars (1993).

For Sanmatenga, soil unit differentiation was based on the frequencies of local soil units by geomorphological/geological unit (Nébié et al., 1995) correlated with FAO soil types (Driessen et al., 1997). The geomorphological units themselves were derived from LANDSAT TM images (Van Asten & Van de Pol 1996).

A similar procedure was used for the other areas.

Degradation indicators

Land degradation is apparent from a number of processes, which can be characterised in terms of degree, stage, and rate (Mulders & Wiersum, 1995). Erosion, loss of vegetation cover, and loss of soil organic carbon were identified as relevant in the West African context.

Rate of erosion

Evidence of landscape denudation since the late Pleistocene (15 000 years B.P.), and Sub-Boreal period (4 000 years B.P.) indicate a surface lowering of between 1 and 5 mm annually. Hoogmoed and Stroosnijder (1995), Casenove and Valentin (1989) and Stoorvogel and Smaling (1990) all suggest yearly soil loss in the Village System of 5-20 t ha⁻¹ which corresponds to some 1 mm yr⁻¹. Applying these values to the system under investigation, only in the soil groups Regosols and Lithosols had loss of soil depth any effect on simulated production potential.

Loss of vegetation cover

Aeolian sedimentation during the late-glacial period deposited scattered sand dunes and silts over the footslopes of hills and plateaux. Subsequent erosion of the footslopes has led to deposition of the former aeolian material over tracts of the lowlands. These sediments are prone to crusting which sharply reduces the infiltration capacity, and such areas are nearly bare of vegetation (Leenaars 1996) – they are known as Zipélé in Moré or Kollangol in Fulani. Once spots of sealed soils start to merge, erosion accelerates sharply. The inventory of the vegetation cover in the Sanmatenga area was based on tabulated occurrences of Zipélé per geologic stratum (Nébié et al. 1995). Similar values were assumed to apply to geological strata in Zoundweogo and Dogon. For selected villages, the occurrence of Zipélé was estimated by means of TM images of 1986. Occurrences were related to the situation in 1960 and the rate of 'loss of vegetation cover' between 1960 and 1992 was estimated by linear interpolation.

Loss of organic carbon

A yearly loss of 1% of resident soil organic carbon was assumed for all situations. It is evident that this assumption must be reconsidered if the cropping index (period of cultivation versus period of fallow) changes.

Simulation of biophysical carrying capacity

To simulate water-limited crop production potentials, the crop growth model PS 123 of Driessen and Konijn (1992) was used, modified to allow the simulation of the impact of land degradation on crop productivity.

Nutrient-limited production was calculated by assuming a nitrogen recovery fraction of 50% for all situations and all years. Multiplying nitrogen sufficiency (i.e. calculated availability relative to requirements for water-limited potential production) by the simulated water-limited production potential yielded simulated nutrient-

limited grain yields which appeared to correspond rather well with actual yields. Figure 4 shows the performance of sorghum on lixisol soils in the Sahel.

Biophysical carrying capacity (ccl.) per Village System was based on calculated production of grain assuming that one person requires minimally 250 kg grain/year). Estimation of the yearly ccl. per soil type was done using both water and nutrient-limited crop growth potentials per soil type. The calculated values were subsequently aggregated and yearly grain production was related to that calculated for the last year of simulation (1992), when consumption was assumed to be equal to production. Figure 5 suggests that the sufficiency of food supply at assumed constant consumption (sic) decreased sharply to a minimum value but recovered thereafter for the Dogon and Sanmatenga Village Systems.

Numeric scores for the change of carrying capacity as reflected by the sufficiency of production are provided by the slope angles of linear regression lines, calculated for the period from 1980 until 1992. **Figure 2.2.6** presents the calculated trend lines. Numeric scoring of the rates of change of the underlying processes was done in a similar way, with yearly absolute values interpreted relative to the values calculated for 1992.

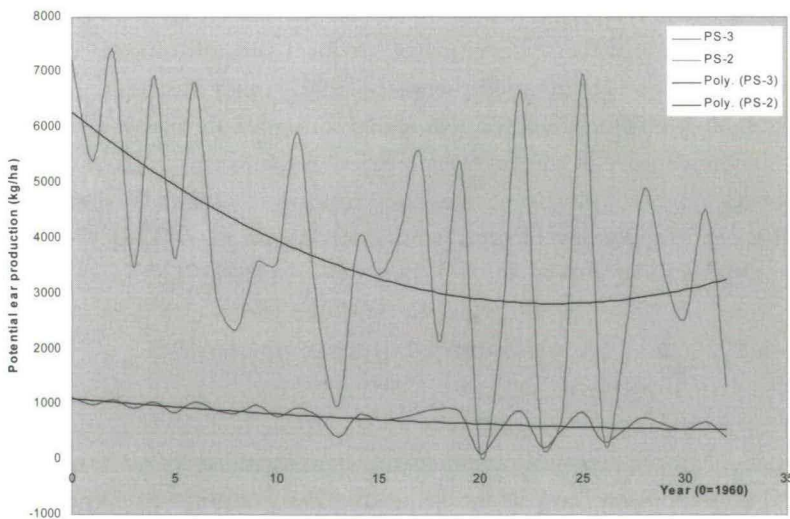


Figure 2.2.4 Simulated water-limited (PS2) and water- and nutrient-limited (PS3) production of sorghum on lixisols in the Sahel

The relation between carrying capacity of land and psychological carrying capacity

Multivariate analysis

Table 2.2.1 shows that average stress and marginalisation figures are highest in Dogon region with the lowest rate and highest state of degradation, with a remarkable disparity

between the Dogon region and the Kaya region. In all regions, females were more stressed than males whereas males were more marginalised than females except in the Dogon region.

A multivariate analysis was carried out, with stress and marginalisation as dependent variables. Gender (2 levels) and area (3 levels) were the independent variables. Table 2.2.2 presents the estimated effect sizes and their significance.

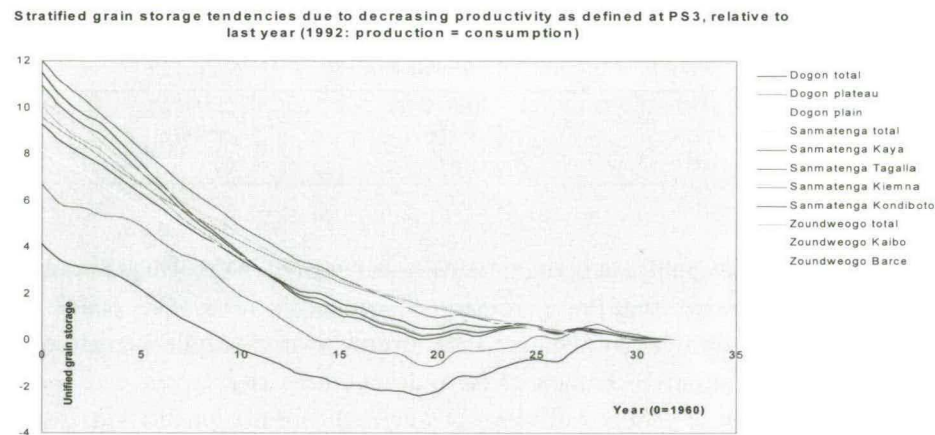


Figure 2.2.5. Simulated sufficiency of grain production relative to 1992

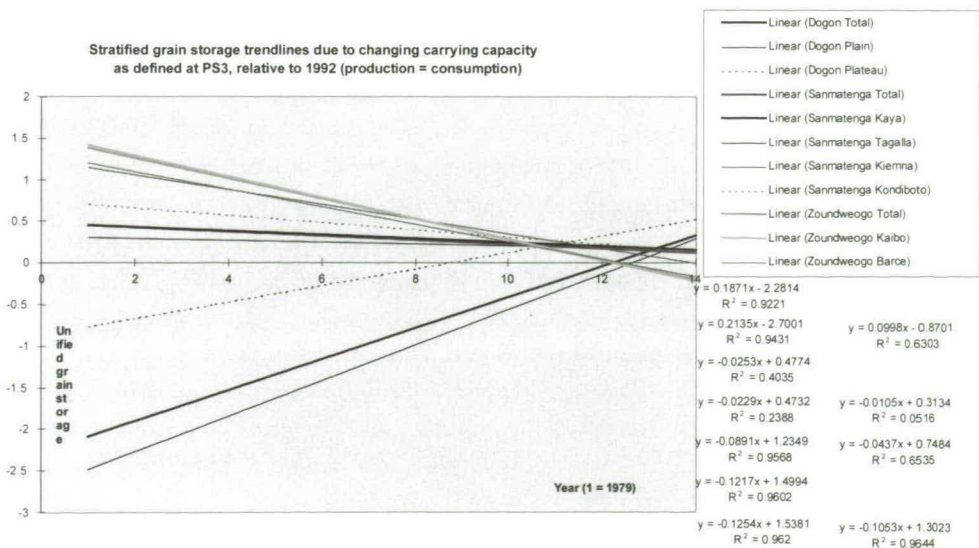


Figure 2.2.6. Rates of change of the sufficiency of grain production since 1979

Table 2.2.1. Average Scores for Marginalisation and Stress by Gender and Level of Degradation

Degradation	Marginalisation	Stress			
		Females	Males	Females	Males
Slow	High	23.58	22.55	32.94	28.44
Medium	Medium	17.31	20.24	30.55	26.59
High	Low	17.21	20.02	30.03	25.51

Table 2.2.2. Estimated Effect Sizes of the Multivariate Analyses of Variance with Degree of Degradation (A) and Gender (G) as Independent Variables and Marginalisation and Stress as Dependent Variables

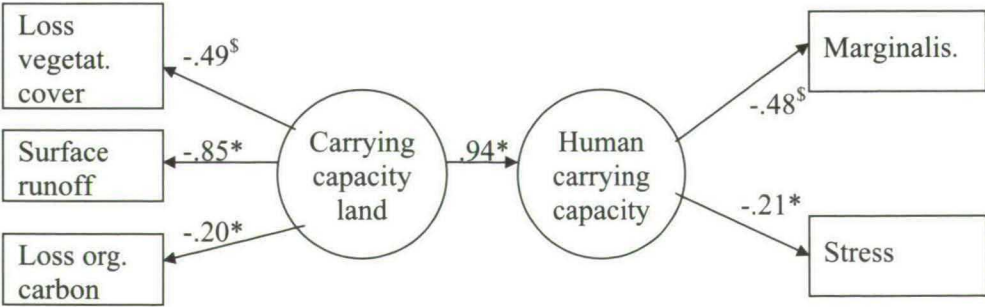
Source	Multivariate	Marginalisation	Stress
Gender (G)	.32***	.09***	.23***
Area (A)	.22***	.37***	.08***
G x A	.06***	.10***	.00

***p < .001

Gender differences were significant, both multivariate and univariate. Compared to women, men scored higher on stress and lower on marginalisation. The main effect of area was also significant, both multivariate and univariate. In areas with the highest state though lowest rate of degradation the highest stress and marginalisation scores were found. Finally, the interaction of gender and area was significant for marginalisation; gender differences were smaller in the most degraded region than in the two other regions.

Structural equation modelling

The relationship between cover, surface runoff and loss of organic carbon as input variables and stress and marginalisation as output variables was examined using a structural equation model (Figure 2.2.7).



\$ Fixed parameter

Fit: $\chi^2(4) = 3.15, p = .53$

* $p < .001$

Figure 2.2.7. Structural equation model of psychological and biophysical carrying capacity (standardised solution)

A good fit was found for a model in which the three soil degradation indicators define a single underlying latent variable, here called carrying capacity of the land. Surface runoff and loss of organic carbon showed a significant, negative loading on the latent factor (to avoid identification problems the loading of loss of vegetation cover had to be arbitrarily fixed). Similarly, the two psychological measures define a single latent variable, dubbed human carrying capacity. Stress showed a significant, negative loading on human carrying capacity (the loading of marginalisation was fixed). The fit of the data was excellent ($X^2(4) = 3.15$, $p = .53$; Adjusted Goodness of Fit Index = .99; Nonnormed Fit Index = 1.00; no significant modification indices for any parameter).

The most interesting part of the analysis involves the relationship between the latent variables. The regression coefficient of biophysical carrying capacity, explaining human carrying capacity, was .94, which is highly significantly ($p < .001$); carrying capacity of the land explained 88% of the variance of human carrying capacity. Carrying capacity of the land had a strong, positive influence on human carrying capacity. This finding means that for the Fulani, human carrying capacity, as measured by stress and marginalisation, is strongly related to environmental degradation.

Implications

The present study has theoretical and practical implications. We have found that despite the very different ways in which biophysical and psychological data were gathered, it has been possible to combine them to better understand environmental degradation and its effects.

In the Sahel, traditional tenure rights have become insecure. The transformation from a traditional system of tenure and grazing rights based on *palavres* and family to a system based on titles and bureaucracy leads to inevitable tension, based on loss of social security. Higher degradation can easily result in the loss of tenure rights, which might underlie the higher marginalisation levels for men confronted with processes of degradation. However, it is unlikely that marginalisation will show a uniform gender differentiation at all levels of degradation. If the environment is seriously threatened and established patterns of subsistence are jeopardised, the gender with the responsibility to take care of the land will show more marginalisation.

The strong relationship of the carrying capacities of humans and land is important to participative management of natural resources which has been put forward as a precondition for sustainable land use. The present study shows that psychological factors may impose limitations on active participation. It is unlikely that groups that are highly marginalised will be motivated to assume an active role in management of natural resources. Highly stressed and marginalised groups may well become inert and may cease to display coping behaviour. For governments, it is very difficult to keep in touch with psychologically marginalized individuals who no longer see any use in being part of a group. Secondly, groups experiencing high levels of stress and marginalisation are susceptible to various psychological problems such as depression. Moreover, there are

indications that a growing deficit of proteins concurrent with land degradation induces serious health problems.

Neglecting the relevance of psychological factors may well lead to ineffective management of natural resources and to avoidable conflicts between government and local population. However, communication problems created by high stress and marginalization levels will be hard to overcome. Social implications can easily become psychologically more important than the degrading environment - such as the need to generate income in an alternative way (l'exode), the challenge of traditional roles in society, and a dim future perspective.

Environmental degradation and its psychological aspects are continuously interacting. Erosion in an environment induces changes in people's behaviour that may accelerate degradation. Strong feelings of marginalization can give rise to migration and to neglect, and accelerated degradation of the environment. However, the onset of erosion may also lead to behaviour that will effectively cope with the threat. The choice of coping strategy has implications for the management of natural resources. Unfortunately, we do not have much insight in the determinants of the choice or in the dynamics of the psychological processes associated with degradation processes. Further anthropological research is needed on differences in stress and marginalization between gender groups and cultural groups.

It could be conjectured that the role of psychological stress and marginalization levels in the management of natural resources follows a threshold model: mild or moderate levels will scarcely influence communication. However, beyond a threshold level, these processes block efficient communication and interfere with management. Future research will need to further specify critical threshold values and to define social and psychological indicators of high stress and marginalization levels. Management of natural resources below and above the threshold is likely to need wholly different approaches in order to be effective.

Acknowledgements

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Chapter 2.3

Land Care and Culture

Brian Roberts & E. Heleen van Haaften (in press).

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Introduction

To understand individual human behavior it is necessary to understand cultural as well as biological features of our species in general and the function and role of agricultural production on population level in particular. We have used the ecocultural model of the Cross-Cultural Psychologists as the basis for our discussions for this chapter and added agricultural production as the interface between the sociopolitical and ecological contexts.

For our approach we determine very broadly three kinds of populations that have to deal with agricultural production: gatherers/hunters, settled farmers and urban citizens. Hunters/gatherers have almost disappeared from the globe (together with their knowledge), and populations of farmers in western societies are declining to less than 5% of the total populations. We are heading toward large populations of urban citizens that have little appreciation of the environment or the basic behavior that is needed for sustainable use of natural resources to get food. This seems to be becoming the future model for large parts of Asia, Africa and Latin America as well.

The increasing lack of local populations, who are able to grow food and fiber, makes agricultural production more and more dependent on technological developments. The current challenge seems to be that up till now science has not prevented the environmental degradation at a global scale. The IFPRI-Report (1999) records severe degradation in the past fifty years of:

- 18 percent of forest land
- 21 percent of pasture land
- 37 percent of cropland.

In spite of this situation and an increased search for solutions, the so-called chain management (vertical integration) of agricultural production managed by large firms seems to be the only model of adaptation for food production. In this model food production is controlled by large multinationals from 'paddock to plate'.

Agriculture is different from the manufacturing industry. The ecosystems in which we produce are highly complex and cyclical. In addition our environments are part of our mental and cultural life such that they can't just simply be transformed into the requirements for a simple linear economic production chain.

People concerned with management of natural resources know that neither the environment nor most human cultures are inherently democratic or participative. In the near future especially agriculture as the interface between nature and culture will require considerable democratic skills to manage their national resources.

There are inherent conflicts between certain attributes of rural communities in developed countries and the need for communal action in solving certain sustainability problems. The democratic process combines the strength of majority rule and the weakness of selfish goal setting in the sense of encouraging voters to avoid the unpopular decisions.

Democracy is a mixed blessing from the resource management viewpoint. In Australia it postpones the need to face up to the ultimate necessity of tough decisions on contentious issues such as water allocation, water pricing, chemical pollution, stocking rates, tree clearing and water quality control. It is clear that the rugged independence so characteristic of many farmers can act as a serious impediment to collective adoption of best practice, which is so vital to solving many sustainability problems. Pest control and improvement of water quality are good examples of resource issues, which cannot be solved without communal agreement and cooperation. At the same time it should be remembered that the alternatives to democracy are autocracy (dictatorship) or communism. It has often been said that benign dictatorship (in the guise of strong leadership) could solve rural problems quicker and cheaper than the frustratingly slow democratic processes of participation and consultation.

Increasingly the democratic process, despite its weaknesses, has been seen as an essential element of the process of gaining what is termed 'community ownership' of resource management plans, eg. catchment plans or water allocation plans. Such ownership infers personal commitment to making the agreed plan work, through implementation by all landholders in the program area.

Mercer (1991) has identified four major goals for environmental action, namely goals related to community or environment on one hand, and to equity and efficiency of resource policy on the other hand. (See **Figure 2.3.1**)

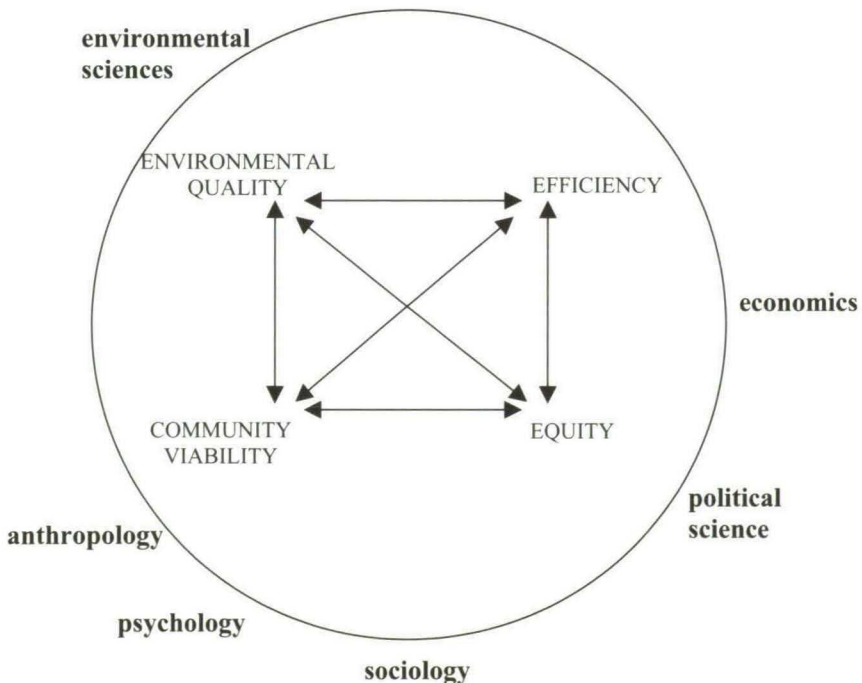


Figure 2.3.1. Content foci in environmental research (Source: Mercer, 1991)

Each of Mercer's goals represents worthy objectives which should not be regarded as mutually exclusive. Rather they should be accepted as of equal importance and dealt with simultaneously through participative processes. The challenge for democracy is to handle complex problems in an amicable manner within acceptable timelines.

The rural democratic process works best when there is a clear realisation that agricultural systems of production not only have links to social and natural systems but importantly have long-term responsibilities toward these two groups of systems. Bawden's (1983) first attempt to display these relationships graphically, form a useful visual reference point. (See **Figure 2.3.2**)

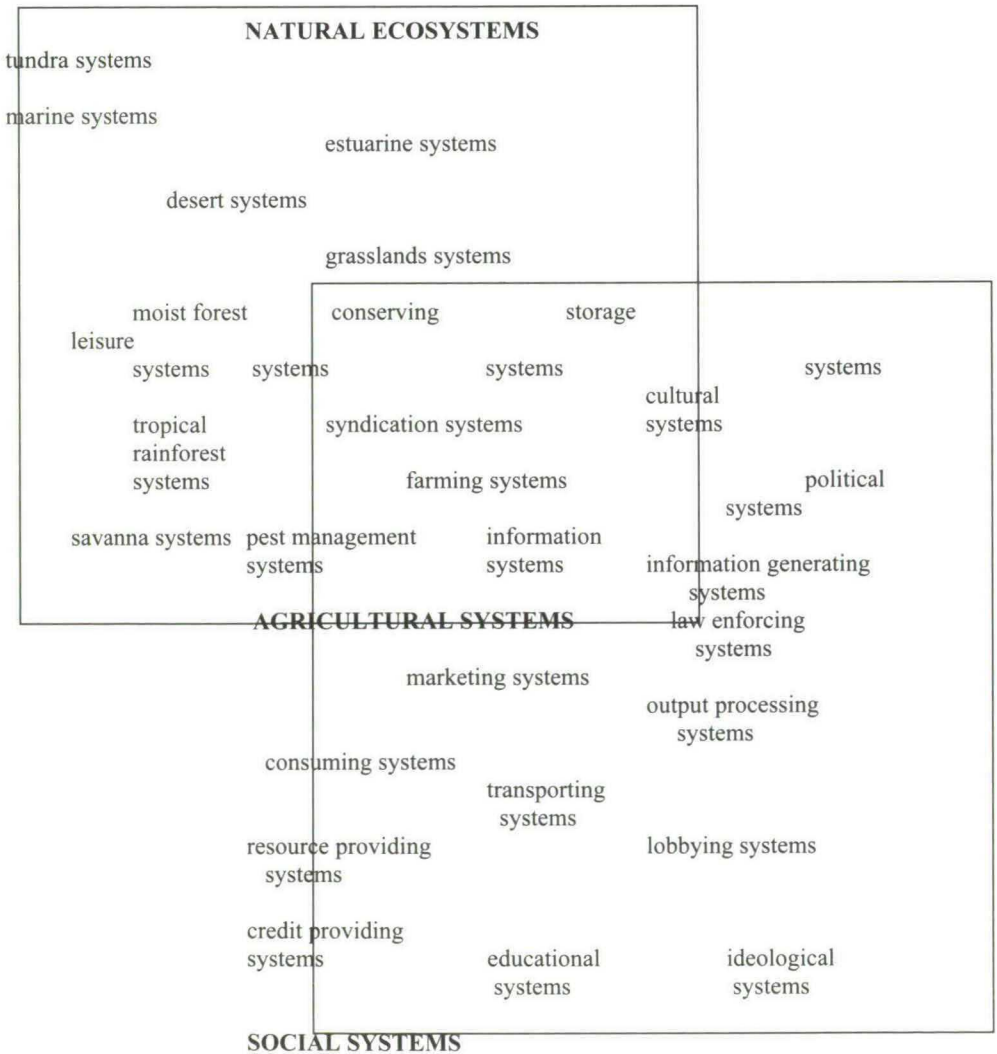


Figure 2.3.2. Overlapping systems (Source: Bowden, 1983)

Attitudes towards nature

People reflect their opinion about reality in their attitudes towards nature. Theories about the relationship between humans and their environment can be derived from natural or physical sciences (ecology, physics etc.) or from social and behavioral sciences (e.g. economics). In the social sciences, there is the on-going discussion of man as a part of nature, compared to man and culture against nature (e.g. the nature-nurture discussion in psychology). This may be stated as: 'Man inhabits two worlds. One is the natural world of plants and animals, of soils and airs and waters which preceded him by billions of years and of which he is a part. The other is the world of social institutions and artifacts he builds for himself, using his tools and engines, his science and his dreams to fashion an environment obedient to human purpose and direction' (Kates, 1988).

In a study quoted by Arcuracy (1990) attitude toward nature was subdivided into (a) balance with nature; (b) limits to growth; and (c) humans over nature. These are reflected in the work of the philosopher Zweers (1995), who defined 6 different attitudes towards nature:

Man as despot. Man as an absolute governor who modifies the environment to his need, without any consideration.

Man as enlightened governor. Man governs nature but is conscious of the dependability on nature, the limits of its resources, and the resilience of ecosystems.

Man as steward. Man manages or governs in the name of somebody else. He is accountable to a supernatural authority or to society, including the next generations.

Man as partner of nature. The image of partner makes this option quite different from the preceding concepts, because one works with a partner on the basis of equivalence to attain a common goal.

Man as participant of nature. This reflects the specific human capacity to be part of nature in his own way, by recognizing the value and experiencing the meaning of nature.

'Unio Mystica'. This concept is directed towards religiosity and identification ('Oneness with nature'). One cannot consider this position in a reflective way (Zweers, 1995). Onduidelijk wat je bedoelt.

In their study in Cameroon Van Haaften and Henrison (1996) found significant differences in attitudes to nature between stakeholders and groups of experts. Through factorial analysis, two factors were compared (Figure 2.3.3), designated as 'relative care for nature' and the 'relative distance from nature'.

It appeared that the three direct users of forest resources, i.e. the Bantu farmers, the nomads, and the commercial loggers were all considered to exhibit a very small distance from nature. Their relative care for nature however was judged completely differently. Loggers were seen as the least careful group without any consideration, while the nomads (Bagieli) were considered as the most caring and participating group as judged from the

perceptions of interviewees. Interestingly, different groups of scientists seem to repeat the pattern found among the users of forest resources: i.e. the ecologists were considered to exhibit the most caring attitude and the production scientists, in this case the forest scientists, the least.

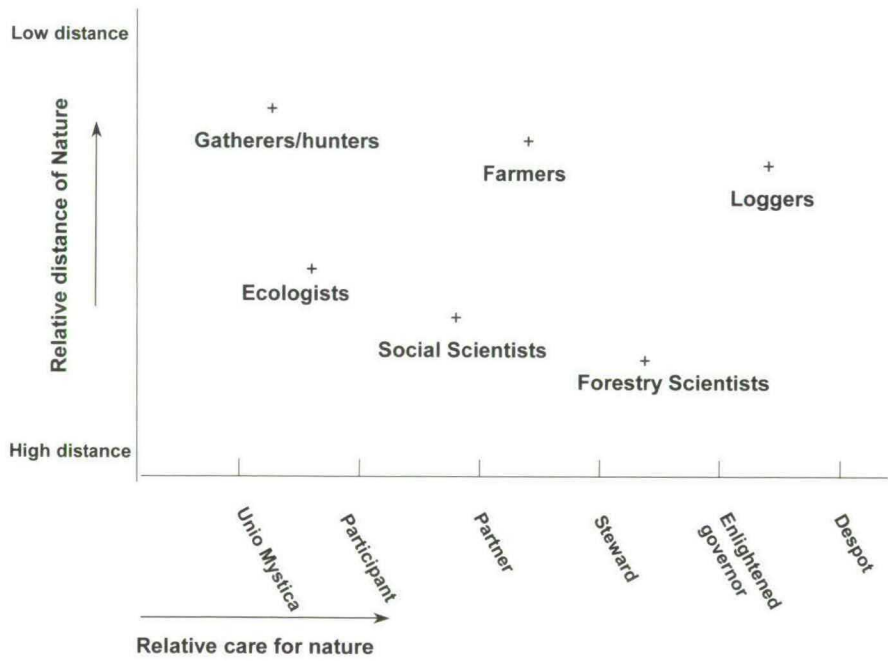


Figure 2.3.3. Relative positions of various professions to two factors composing Attitudes towards Nature

Tragedy of the Commons

Garrett Hardin's (1968) well-known (and perhaps over-used) analogy of the way in which the health of common grazing land is determined by individual constraints, remains a useful paradigm for resource sharing. In the commons example, it becomes clear to all families who own milk cows grazing on the town common that unless the total stocking rate is kept within the carrying capacity of the common pasture, all families will suffer. From the individual family's viewpoint there is a temptation to maximize their milk supply, but degradation from overgrazing makes all families recognize that without agreement on maximum allowable cow numbers, the milk yield per cow decreases and ultimately the pasture collapses. This simple case study in balancing private benefit/ public good has been interpreted in several different ways. In the present context it is seen as a necessary element in future agricultural planning where the common good is given priority over maximizing private benefit.

The concept of Dominion over Nature

In seeking the reasons for land degradation in developed and underdeveloped countries subject to colonization, one soon arrives at the fundamental values, which characterise different societies. There is little doubt that greed and misinterpretation of having dominion over Nature, has bred generations of land users who recognize no intrinsic (spiritual) value in Nature beyond its utilitarian usefulness to humans as a supplier of wealth-generating resources.

The absence of a respect for Nature and an appreciation of deeper values of fellow living organisms contrasts much of Western belief systems with the more inclusive stance taken by several of the great Eastern religions. Evans, Mayes and Martinello (1983) in their remarkable comparative overview titled 'What people Believe', give a plain and objective evaluation of these important formative forces in world agriculture.

In 1967 the American Lyn White published a seminal paper in the prestigious Science Journal. Several writers before White had suggested that the basic cause of land degradation lay in a fundamental lack of respect for Nature. White's title 'The Historic Roots of our Ecologic Crisis' has always drawn the attention of analysts who seek to remedy degradation at its origin. While the defensive responses and denial from religious leaders were not unexpected, it is clear that a lack of spiritual connectivity to the land by materialistic societies is not the only causal factor in today's environmental crisis.

Population pressure has negated the beneficial influences that can stem from Human/Nature links in societies that practice Tao or Zen Buddhism in which individuals aim to be at one with Nature. Nash (1989) has suggested that mankind's very definition of ethics has moved from being concerned only with interpersonal relations, to a wide Human/Nature relationship in which biodiversity replaces the earlier narrowness of ethical behaviour (Figure 6.4). So rather than doing away with the concept of dominion, Daly and Cobb (1989) suggest that improved relationships with Nature can be achieved, not by renouncing dominion but by better ways of exercising it, ie. as responsible stewardship.

Several writers have pointed to the commonality of values between modern Deep Ecology and the ancient Chinese Tao teachings. Both views recognize humans as part of, and integral to Nature - the difference between 'the land belongs to us' and 'we belong to the land'. In both cases the concept of 'dominion over Nature' is replaced by 'in harmony with nature'.

Boyden (1991) of the Australian National University suggests that the Western cultural soup' constituting our society is short of a crucial ingredient. This he describes as an absence of understanding of nature, the inter-dependence of living systems, the place of humans in nature, and the relation between cultural and natural processes.

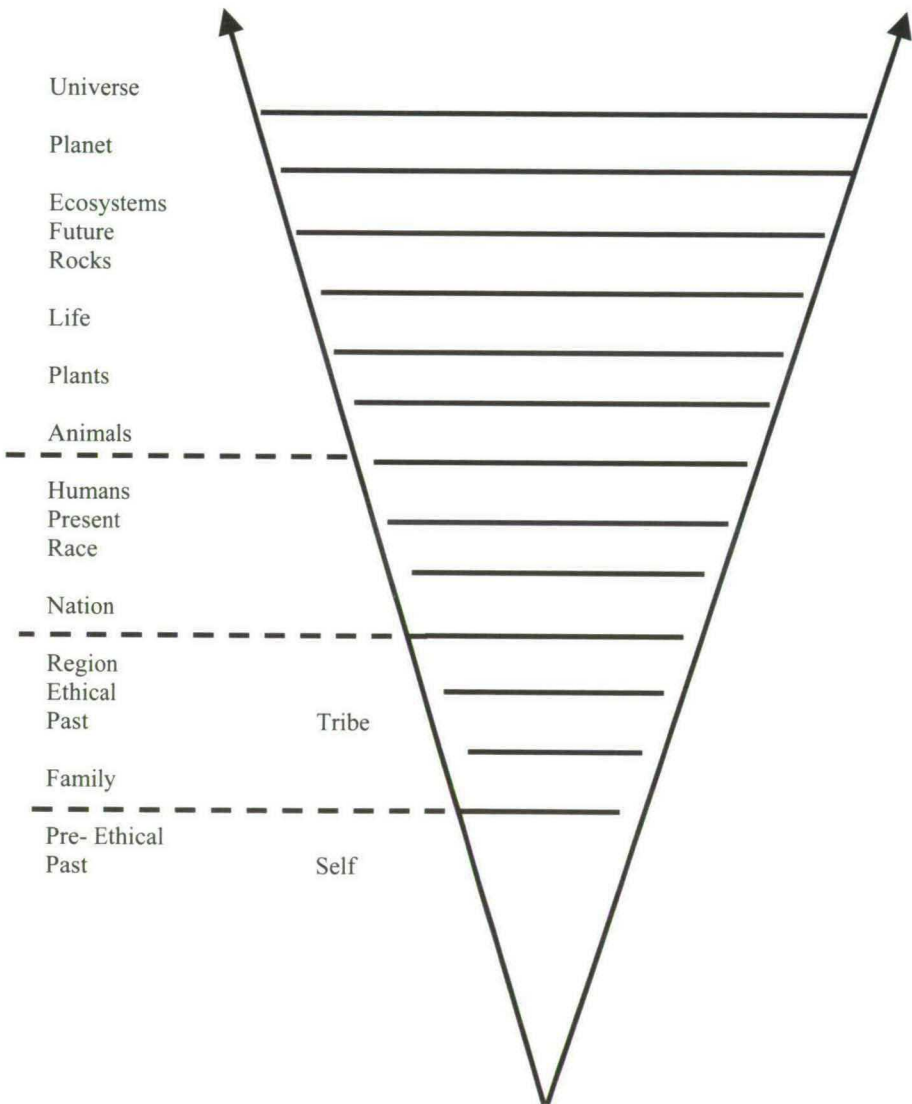


Figure 2.3.4. *The Evolution of Ethics* (Source: Nash, 1989)

De Witt (1987) on the other hand believes that Western societies' fundamental deficiency lies in the fact that our institutions have developed largely in the absence of global environmental awareness while Daly's (1980) attempt to stem reduce? the damage through steady-state economies continues to meet opposition from the industrial growth promoters of the global economy. Daly argued that 'steady-state' does not imply no growth, but importantly a different type of growth, i.e. a growth in quality of life, appreciation of non-material values and a new concentration on personal relations. Daly and Cobb's (1989) title 'For the Common Good: Redirecting the economy toward Community' embodies this shift in qualitative growth. History tells

us that human nature's desire for comfort and convenience leads to our not responding to the early-warning signals of environmental breakdown. Is this the reason why society delays intelligent response to degradation until it has no option? Capra (1982) in his milestone publication 'The Turning Point' says 'Deep ecology is supported by modern science and in particular by a new systems approach, but it is rooted in a perception of reality that goes beyond the scientific framework to an intuitive awareness of the oneness of all life ... it becomes clear that ecological awareness is truly spiritual'.

The old Tao and new Deep ecology share a number of basic tenets:

- All life has inherent value irrespective of value to humans.
- Biodiversity is a value in and of itself.
- Humans have no right to reduce the richness of other life forms.
- The flourishing of non-human life requires a reduction in the impacts of human life.
- Current economic, technological and ideological structures require a modern definition of both 'quality of life' and 'a successful life'.
- Individuals subscribing to these values have an obligation to work for change.
- Tribal Spirituality and Feminine Values.

It is indeed unfortunate that the spiritual links between tribal people and their land is somehow regarded as primitive or pagan and thus inappropriate to many modern cultures. Land-based religions such as that of the Australian Aborigines link their followers closely to the earth, rather than to heaven. While it is true that Australia's claim to freedom of religion is complicated by land-based religions, the inability of some cultures to survive in isolation from their land now requires serious attention by government. This 'mother earth' appreciation of resources is seriously at odds with the paradigms of economics in the narrow sense of the cash economy. Kahvari (1993) in his 'Environomics' text attempts to dismantle the myth of perpetual growth and proposes the approach which he terms 'the economics of environmentally safe prosperity'. Like Birch (1983) in his 'Confronting the Future', Khavari recognizes and stresses the redefining of prosperity, but he is realistic enough to recognize the obstacles facing the achievement of environmental goals.

As economic and social pressure has increased on rural women in developed countries, so the contribution of women to the survival of the family farm business has become more crucial. In both the North American and Australian context, the ability of rural women to branch out from their traditional role as homemakers and child-raisers has made the difference between failure and success of many family farms.

While the total number of farming families has been declining for the past 20 years, the rate of decline would have been much greater in the absence of rural women's ability to act as additional farmhands, business managers and off-farm income-earners. The Australian families engaged in the wool industry currently provide a good example of

the difference that such spouse-generated outside income can make to the farm business. This augmentation of disposable income is accompanied by the additional activity of many (perhaps most) rural women to transfer their caring and nurturing capacity from their family to their land. There is ample evidence that women have been the backbone of the Landcare movement in Australia for instance, and their concern for the future of their children on the land, may be driving mothers to this view (Table 2.3.1).

Table 2.3.1. Women Holding Positions in Landcare

Queensland:	Women holding the position of chairperson or secretary of Landcare groups	
	10 out of 107 chairpersons	
	35 out of 107 secretaries	
Western Australia:	Women on district Landcare committees	
	113 out of 650 positions	
Landcare coordinators/facilitators	Queensland	3 out of 8 positions
	New South Wales	2 out of 13 positions
State assessment panels positions	6 out of 70 positions	
Federal Soil Conservation Advisory Committee	4 out of 11 positions	

(Source: Mills, 1991)

Women as a gender group are often given credit for their ability to get group action going through motivation, support and networking. This is contrasted with the stereotypical male behavior, characterized by competitiveness, aggression and desire for individual achievement. There are of course important exceptions in both gender groups, but in general the land ethic and its broader form of environmental awareness are more well developed in women (Table 2.3.1).

Aspirations, Values and Criteria of Stewardship Achievement

The setting of realistic targets for the achievement of sustainable farming systems is influenced largely by the aspirations and awareness of the rural community. The extent, to which such aspirations are financially supported by government, depends in part on the demonstrated concern on the part of the voters at large.

As referred to in another context elsewhere, both aspiration and stewardship goals depend primarily on the community's sense of values, i.e. whether there is a broad-based appreciation that the nation's well being depends in large part on the condition of its natural resources. Thus the value that is placed on soil conservation, biodiversity protection, salinity control and river health for instance, forms the basis for both policy and financial support mechanisms.

In the broader context, the values that a society holds dear are reflected in the way in which its members recognize achievement and the measures by which they gauge success. These fundamental barometers of progress in the most basic sense reflect the extent to which a society has moved towards what has been termed ‘earthmanship’. The motto of one agricultural faculty in South Africa is ‘a nation which protects its soil, protects its future’. This may be somewhat simplistic, but it demonstrates a commitment to a universal truism, which applies to rurally based economies everywhere i.e. ‘look after the soil and it will look after you’.

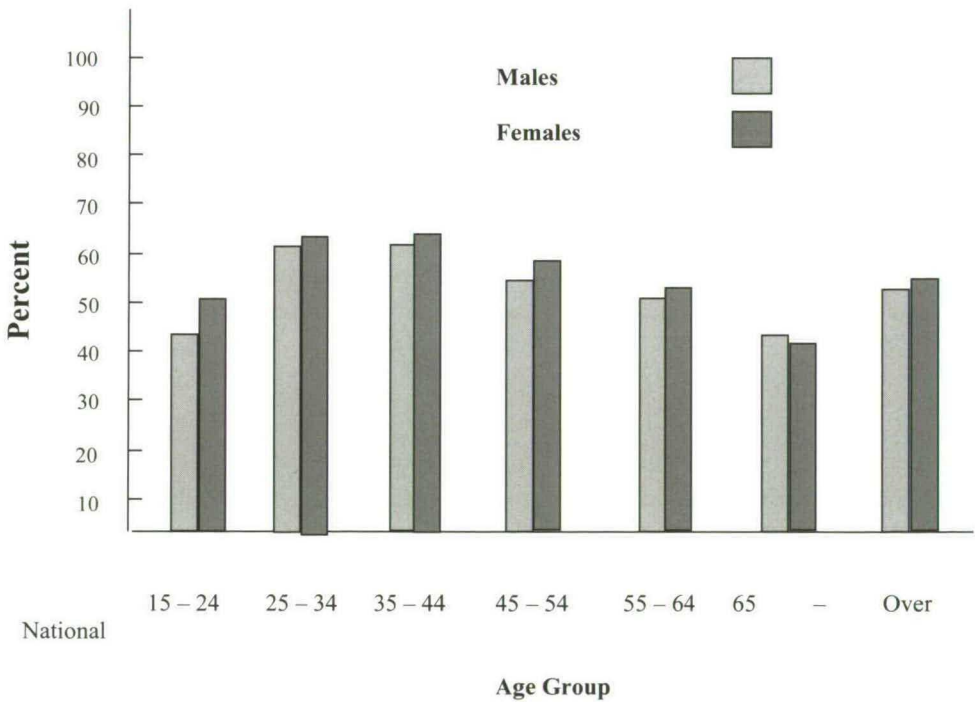


Figure 2.3.5. Age and gender analysis of environmental concern in Australia
Source: Australian Bureau of Statistics, 1986

Once a society embraces a sense of permanence and long-term stability as a major goal, there is a change in the way it acknowledges achievement by its members. This change incorporates a conscious sacrifice or discounting of short-term profits for a more worthy ideal, namely what psychologists term ‘delayed gratification’.

The affluence born of rampant materialism is replaced in earthmanship by more fundamental measures of success, e.g. quality of life, better health, pride in frugal living and acknowledgement of environmental improvement. Societies which hold these views measure their success in more basic terms than financial terms and the rural communities of several Scandinavian counties for instance reflect this lasting and balanced

worldview and their place in it. It implies a shared national long-term vision which has not existed in Australia to date, but which is currently gaining momentum as the gravity of salinisation gains political recognition. In contrast, the Dutch have long recognised the need to act against groundwater pollution and have instituted a nation-wide audit of nutrients leaving each farm. This 'balance sheet' approach offers an effective monitoring system for pollution control at the production unit level.

Australian aspirations – a comparative view

The personal and social goals of Australians probably differ more within their own communities than between Australia and other countries. The great divide between urban and rural people in this most urbanized of all nations, is characterized primarily by their extent of disconnectedness from the land which produces their food.

This consideration of country people's aspirations is limited to rural communities dependent on agriculture, rather than on mining that is the major income-earner in the vast arid zone. In a young country, which draws on a short 200-year history of settlement, basic survival instinct is undoubtedly a significant factor in how landholders view their relationship to Nature. In more recent years, increasingly since World War II, financial survival has surpassed physical survival as the central factor determining how land is managed.

The extent to which Australian rural communities' aspirations are different from those of other nations is a matter for conjecture. However, the stereotype of the fiercely independent 'battler' who detests government intervention, is still alive and well in parts of Australia. This is particularly so in the outback pastoral country, where survival has depended on individual judgement and a higher than usual level of tenacity, self-sufficiency and dogged determination. In isolated regions (Roberts & Walker, 1994) the aspirations of pastoral families do not reflect the desires of the affluent coastal communities. On the contrary, many outback families seek only very modest living conditions and a minimum of outside interference.

Aspirations concerning land condition and environmental health of rural ecosystems has changed since the mid-1980's and is currently changing even further toward greater ecological sensitivity. This change is geographically 'patchy' but overall approximately 36% of landholders surveyed claim to be active in some facet of Landcare, Integrated Catchment management or other Conservation activities.

This tide of rising environmental awareness causes a conflict between the independent operator and the community-minded operator who recognizes the need for integrated land management across the whole catchment. The vast distances between neighbours has been a major formative element in the well-developed sense of independence of inland Australians - what Blainey has referred to as 'the tyranny of distance'.

Women's aspirations, indigenous aspirations

Individuals within rural communities generally aspire to have something, do something, or be something beyond their present situation. As referred to earlier, rural women in Australia appear to have considerably more clearly-defined aspirations relating to family and land well-being, than their men folk do. It is this strongly developed striving for a better quality of life for their offspring which leads to severe trauma among mothers when the decision has to be made on whether children are advised to return to run deeply-indebted properties.

Indigenous aspirations relating to land are very different from those of the descendants of European settler communities. The central reason for this is that Indigenous people regard themselves as being integral to the land, being a function of the ecosystems, and being without direction or purpose when separated from their land. This is not to infer that urban aboriginals or town fringe-dwellers have not survived, but rather that once tribal bonds with their 'country' have been broken, their social fabric, behavior and self-respect decline to a point of near collapse in many cases.

Because Indigenous people also recognize their land as the direct source of both physical and spiritual nourishment, their aspirations center on continued contact with their landscapes and biota. What is meant by a family's 'country', is not any land, as in desirable real estate, but the particular country to which they are bonded by the burying of their placenta at birth at the site of their origin.

Land ethics – Do they really exist ?

A decade and a half ago the author (Roberts, 1984) analyzed the current level of acceptance of a land ethic under the title 'Land Ethics, a necessary addition to Australian values'. He argued that ethical behavior is based on a moral imperative to do the right thing, and he recognized equally valid ecological, social and theological motivations for ethical behavior toward the land. Today there is a growth industry termed 'ethical investments', a latter-day economic response which plays on investor's environmental awareness and concerns for the future of our finite globe.

In a hungry angry world caught up in nationalist conflicts, reliance on altruism and Good Samaritanism may appear to have less than a fighting change of success in saving global productivity. While food-producing potential and its diminution is understood and recognised by many, the more esoteric elements of the land ethic, such as preservation of biodiversity, have yet to gain acceptance among the masses. These masses constitute some 80% of our current global 6.2 billion people and they carry the burden of our having only an average of 0.2 ha of cropland per capita available for global crop production. With human population increasing by 94 million annually and cropland land being lost to degradation and urbanization at 7% per decade, the challenge to adopt sustainable agriculture requires a more intense sense of urgency.

Allied to soil loss as a global constraint to quality of life, is water – both amount and quality. Clean water has long been recognised by social planners as the number one

limiting factor to community development. Equally, water shortages constrain settlement more than any other single factor.

Land ethics can be expected to move from the purely esoteric to the pragmatic survival values once the inevitability of the population/cropland equation is recognized. While ever temporary (in historic terms) food surpluses prevail and depress export prices it is unlikely that the true acceptance and appreciation of a land ethic will occur on any extensive scale in western societies. Malthus will eventually be proved to have been correct.

Currently several forms of land ethics are recognized: one well-known form is that made famous by an alleged speech by chief Seattle, later discredited as a Hollywood script. Another is the original 'mother earth' concept of the Australian aboriginals, the oldest living culture on earth. The more recent western land ethic promulgated by Aldo Leopold in the US in his 'Sand County Almanac' (1947) has inspired the more visionary members of the developed countries who recognize the need to break away from the mindset that sees Nature only as wealth-generating resources.

Tenure and farming systems

Does Tenure influence Stewardship?

In western cultures there is a tendency to link the way we nurture the land to the level of ownership or permanency of tenure. The assumption is often made that unless we own the land we are unlikely to respect it or to sacrifice short-term gain for long term productivity. The major reason why such a large percentage of Australian pastoral land is leasehold is that originally very few squatters had the finance to purchase freehold blocks of grazing land. While many state laws make provision for penalising lessees who damage the land through overgrazing, very few such cases have been brought before the courts. The reason for this is twofold:

- First, governments are aware of the extent to which lessees are at the mercy of the elements, notably drought, making them 'battlers' deserving of sympathy.
- Second, distinguishing between managerial and climatic causes of degradation of natural pastures is complex and difficult to quantify.

Returning to the freehold/steward debate, it is generally believed that ownership breeds a pride and appreciation of land resources. The benefits of stewardship make land ownership a dependable long term investment – an asset from which future productivity is less at risk if the resources, e.g. natural pastures or annual cropland, have their productive potential maintained by conservative use.

Beyond western agricultural tradition in which freehold ownership is regarded as necessary for custodial values to characterize land use, is the indigenous tradition in which communal dependence on land and respect for spiritual values, replace individual benefit (and greed) and emphasize the common good as the essential outcome of land management.

How free is freehold?

As population grows and as resource security becomes a more dominant driver of equitable sharing of land-based benefits, so previous notions of property rights come under greater scrutiny.

The global triad of environmental problems identifies population, pollution and resource depletion as the fundamental three-fold constraint to the human condition. Prior freedom to act only according to the landowner's independent desires has given way to more recently accepted values such as diligence in conserving our base resources such as soil. The rise and expansion of Codes of Practice, Greenlabelling and Environmental Indicators has led to a recognition that freeholders are no longer free to treat the land as they like, especially not if such treatment diminishes the benefits to what has become known as 'inter-generation equity'. This principle enshrines the right of future land users to have at least the same benefits from land as present users enjoy. From this was born the widely-held value of 'sustainability', and it is this fundamental criterion by which future land use is to be judged, that represents the great divide between past and future agricultural systems.

While the terms 'sustainable' and 'best practice' have been over-used and are due for replacement (or at least an overhaul) the basic requirement for permanence remains an essential feature of acceptable future modes of land-based production. The same long term stability is also the major objective of marine systems management in which the rate of harvest of global fish stocks is required to meet scientifically-based harvest capacity estimates in this form of underwater hunting and gathering. Similarly with forestry.

The holding of freehold title to farmland however, in no way guarantees independent action in future land use decisions. Responsibilities to others in time and space will increasingly become a central element of land use policy. It will be encouraged and supported by cost sharing arrangements and institutional mechanisms which reward individual responsibility on behalf of the community at large.

Increasingly 'the community' will become defined in ever-expanding geographical terms, so that the move from family farm to catchment to region to nation, will extend to the global village. This will occur as pressure from the 'have nots' on the 'haves' becomes a real threat to food security. The process will be accelerated by international agreements on environmental certification of major food commodities in the same way that green labeling already applies to timber production and organic food.

The freedom of action on private land will thus be constrained by meaningful economic forces operating through both the size of markets and the quality of produce as gauged from certified best practice.

The earlier concept of 'worlds best practice' may be toned down to 'current best practice', but the drive to differentiate environmentally-friendly products from those of the outmoded 'cowboy economy' will eventually force compliance with new standards.

Lease conditions and rewards

In countries such as Australia, where vast tracts of land are held as leasehold, there is a need for incentives if lessees are to demonstrate the level of stewardship required to maintain productivity.

Wide combinations of educational, incentive and regulatory approaches to encouraging permanent production on leasehold land have been attempted. The response to voluntary, market-driven or regulatory mechanisms depends largely on the cultural and socio-economic situation in which each approach is applied.

Mike Young (1979), the Australian resource economist has elucidated the features of appropriate lease conditions for pastoral land in the arid zone. Young recognises security of tenure and extension of lease review periods as important inducements to lessees to not damage their land at least not irreversibly.

The rewards for stewardship of the nation's resources, as may occur on a pastoral lease, should be economic as well as social. If it can be shown that well managed leases are contributing to the greater good of ultimate net social benefits, then lessees are more likely to take pride in being temporary trustees of the national resource. As such they will help develop peer pressure, which discourages the 'fast buck' approach, in favor of a more lasting view of our fragile land resources.

One of the problems of lease holding in the Australian rangelands region has been the difficulty of matching the size of pastoral properties to changing cost-price structures. For instance in the 1950s a sheep flock of 5,000 head was economically viable; in the 1980s graziers required 8,000 sheep to remain profitable, and by the late 1990s the consensus was that unless leases had enough land to carry 10,000 sheep, they'd be forced out of the industry (Roberts, 1998). The most obvious way of overcoming this dynamic of the so-called 'living area' is to offer leases which err on the generous side of lease sizes. Clearly the application of best practices can often increase gross margins, but when globalisation causes a failure of certain traditional markets (such as for course wool), there is a limit to which increased efficiency can maintain producer viability.

In the case of fragile arid ecosystems such as occur in the Australian rangeland, there is a need for changed lease conditions, which offer greater incentives to leasers who wish to restore degraded country. Where range condition is such that a considerable period of restoration is required, new lease conditions, which encourage light stocking and more spelling, are required. Without realistic incentives, motivation to rehabilitate pastures is likely to be lacking.

Balance between regulations, incentives and education*When is intervention justified?*

In the current era of globalisation of free trade, and in Australia's case the National Competition Policy, the earlier Keynesian economic values in which price is a simple

function of supply and demand, have regained its former dominance.

In the absence of compensatory environmental policies, the free market in its unqualified form, can be predicted to deplete natural capital. The reason for this is that natural resources are generally considered as a free good in the economic equation. The depletion of forests, fish stocks, soil and wildlife reflect this truism.

Thus while the free-marketeers have much going for them in terms of the effect of competition on consumer prices, there are some things that are too important to leave to the market place. These include a range of environmental attributes of the finite world within which agriculture must feed our burgeoning population. One of the reasons why these attributes have been neglected is that they are difficult to quantify, eg. soil productive potential, ecological function, biodiversity status, salinisation processes, pest and disease resistance, chemical imbalance and toxicity.

Intervention in free market processes can take the form of incentives or disincentives rewards or penalties. In recent years it has become clear that because very few countries actually account for the condition of their natural assets (Norway and Holland are exceptions), growth and GDP can be shown as positive even when achieved at the expensive of natural capital.

Intervention in the manner in which economic processes impinge on natural resources and environmental health, can be initiated by the simple expedient of including a new line item in the national budget. This item could be termed either 'Repair and Maintenance of Natural Assets' or 'Full Costing of Agricultural Production'. In either case this item should account for losses in productive capacity and ecological function. If this item is excluded, as it has been almost universally in the past, nations can live off their land capital until the point of no return is reached. At this point resource condition is typically irreversible both economically and ecologically. In such a situation, 'the sins of the fathers are visited upon their children's children' and inter-generational equity fails.

Does self-regulation work in agricultural industries?

Sometimes, but only under certain conditions, Voluntary Codes of Practice have become the norm in many branches of agriculture. They are driven more by market insecurity than by any environmental imperative. In fact a number of Codes have consciously been developed to provide a legal defense in the event of producers being sued for damages related either to contaminated products or to human health.

Self-regulation works where producers recognise that the disbenefits from not acting environmentally clearly outweigh the costs of meeting new standards. In the absence of potential loss of market share, there is a temptation to maintain the status quo and minimize costs. In the example of chemical sprays, unless the operator perceives either a clear health risk to the farm family, or is aware of litigation threats from off-site parties, the 'business as usual' approach is likely to prevail. Self-regulation is never enough to entice all operators in an industry to conform to environmental standards.

Experience in industries such as shipping and mining has shown that when self-regulation advantages the irresponsible operators in an industry, heavy fines and cancellation of trading licenses have a predictable effect in focusing the mind of operators on safety and the 'duty of care'.

Rational basis for cost-sharing

Population increase and greater environmental awareness has led to increased demands on landholders to apply sustainable production systems for which there is usually at least a short-term cost.

When the broader benefits of maintaining land, vegetation and water condition are shared by the community at large, it is fair and reasonable that the costs be similarly shared. The author (Roberts, 1995) has summed up the method by which the costs of each type of ameliorative action on farmland can be categorized for costs sharing. Some conservation farming techniques may be regarded as primarily of benefit to the individual landholder, while others such as salinity control can be classed as public benefits.

In addition, some land management techniques such as contour banks or salinity drains have a long cost recovery period. Others, such as nitrogen fertilisation have a short term benefit. These categories of sustainability action allows for the classification of costs into a matrix of four classes for cost-sharing purposes:

Short Term	Long Term	
<i>Private Benefit</i>	Class 1	Class 2
<i>Public Benefit</i>	Class 3	Class 4

This offers a framework for the construction of equitable cost sharing classes. In the above matrix, financial support policy may expect individual landholders to carry the full costs of class 1 activities, with minor support for class 2 activities. In the case of public benefit activities in class 3 a ratio of 50:50 private/public costs recovery may be equitable, while in class 4 a ratio of up to 20:80 can be justified. This latter level of cost sharing is being used in programs such as the capping and piping of bores in Australia's Great Artesian Basin. Cost sharing policy requires a level of community education which convinces voters that the common good is dependent on individual action and that shared responsibility must be translated into equitable policy.

It is not unusual for one or both of two avoidable mistakes to be made in this sphere of policymaking. The first is the perception that rural producers are being 'feather bedded' i.e. that they receive preferential treatment over less privileged groups who are also going through economic hard times. This stance is based on the assumption (often incorrect) that since present landholders caused the degradation, they should fix the problem. The second mistake, which is made, is that support assumes that the above perception is actually true, i.e. that political power in rural areas does in fact lead to significant financial advantage.

This second weakness in cost-sharing policy can be demonstrated by a range of previous financial support schemes in Australia, which have had major socio-economic benefits for rural producers, e.g. drought assistance, phosphate bounty and tax rebates. The 'correct' balance between public and private cost sharing remains a matter of political philosophy to some extent. It refers back to the earlier belief (or myth) of the yeoman farmer, that solid rural citizen who collectively was seen as the backbone of the nation - that class of productive people without whom the nation had no future. While this Adam Smith-type valuing of the agrarian community may be due for a serious re-think, it remains true that those who carry the burden of being trustees of the nations' food and fiber-producing resources', warrant support.

Land stewardship is at the heart of community-based land conservation management. Australian Landcare established over 4500 landholder-led groups during the Decade of Landcare (1990-2000) and predictably their financial accountability came under scrutiny at an early stage. Thus in addition to the issue of equitable cost sharing, the economic value of the investment in land repair becomes a matter of political conjecture. Under the circumstances, protagonists at extreme ends of the cost-sharing scale are not difficult to find. Government's job is to inform the voters of both the necessity and the equity of a fair sharing of the burden of custodial activities.

Changes required in agricultural teaching

Most Agricultural universities in industrial countries are remarkable institutions. In the first place, they focus on applied life sciences, earth sciences, (bio) chemistry, and other largely 'technical' disciplines. They tend, more or less by societal consensus, to teach agronomy, forestry, animal science, soil science, food science, agricultural engineering, and so forth. Hence they usually define themselves as technical universities, because agricultural economics, farm management, and agricultural marketing generally have been recognized as an indispensable dimension of agricultural production. This technical focus means that, even though the human predicament increasingly seems anthropogenic (caused by humans), agricultural universities tend to neglect the 'soft side of land' (Roling, 1997). The fact that land use can usefully be looked upon as the outcome of societal arrangements and conflict, and of human aspiration is generally not well understood in agricultural faculties.

In the second place, most agricultural universities tend to focus on applied science. In this way agricultural universities traditionally help people gain greater control over nature in order to satisfy human objectives. This focus emphasizes dominance and control, rather than participation and adaptation. Yet one can legitimately ask whether we need more human control over nature or a better understanding of humans as part of nature.

In the third place, virtually all agricultural Universities focus on a specific sector of human activity: primary production and the processing and marketing of primary

products, especially food. In fact, supporting the production of sufficient and healthy food through scientific research and education is the mandate of most agricultural universities. This focus has two implications: First, it locks many agricultural universities into an economic sector that has tended to lose relative significance *vis-à-vis* other sectors. The irony is that, while agricultural research has tended, over the years, to assist farmers to become more productive, the benefits of these efficiency gains do not benefit the farmers but are passed on to agribusiness and consumers in the form of continually declining farm gate relative prices. As a result, farmer incomes are under constant pressure - the so-called 'agricultural treadmill' (Cochrane, 1958); the number of farmers in developed countries dwindles by some 2% per year, and jobs in agriculture become scarcer. For agricultural universities this means that their contribution becomes increasingly less relevant politically, they draw increasingly fewer students, and they find it increasingly harder to access funds. And this holds true even if we disregard the bad reputation of agricultural universities as harbingers of the kind of agriculture that industrial societies increasingly do not want anymore. Second, by focusing on primary production, agricultural universities tend to neglect the other natural resources and ecological services that are increasingly recognized to be threatened by human activity (e.g., Constanza and Folke, 1996), like the availability of fresh water, the condition of biodiversity and human genetic integrity.

In all, agricultural universities in their present form seem unsustainable relics of a century during which the capture of the productive capacity of nature through the application of scientific knowledge released enormous amounts of wealth and societal enthusiasm. That century has passed. We are now entering the 'century of the environment'. A single-minded focus on primary production for science no longer seems a sound basis for a lucrative societal contract in an era when the survival value of environment with the consequences for mental and physical health has become clear.

Adaptation to environmental and cultural change

Relation between psychological stress, land tenure and resource condition

Since this chapter deals with the inter-relationship between people and their land, it is useful but difficult to consider the stress-tenure-condition complex. As rural societies develop from subsistence to a trade-based agriculture so they progress from a physical survival mode to an economic survival mode. The level of psychological stress experienced by farming families in developed countries has its origin in the level of risk determined by their financial situation. In developing countries, stress may be more directly related to food security and the ever-present risk of drought or famine. The effect of tenure on stress is through its effect on security, peace of mind and the effects of permanency on both productivity and individuals' willingness to invest in future production systems and infrastructure.

As referred to earlier in this chapter, security of tenure is probably a major motivating force for most landholders but clearly security of tenure alone is insufficient to ensure future viability. In the case of Australian producers for instance, the two great externalities of product price and drought, have such a dominating effect on risk-aversion strategies, that factors such as tenure, efficiency and market research are important but not dominant drivers of decision-making.

Resource condition usually only seriously affects production and thus stress level, when degradation reaches an advanced, perhaps irreversible stage. Examples of such extremely degraded environment can be found in both developed and developing countries.

The physical environment is crucial in the context of human behavior, especially in degrading environments. Severe degradation may result in the complete loss of primary resources and of food and income of local populations. Scholars from many disciplines have become more and more aware of the mutual relations between preservation of the physical environment and cultural continuity, amid concerns for the needs of growing human populations (Berry, Segall, & Kagitcibasi, 1997). Socio-political and technological changes that tend to follow Westernisation processes and exert increased pressure on scarce natural resources, often accelerate environmental degradation. In sum, environmental degradation has both biophysical and psychological consequences.

Different perspectives on assessment of sustainability of agricultural development have been pointed out by several authors (Giampietro (1997)). In spite of minor differences in definitions, there seems to be agreement that at least three fundamental perspectives should be considered:

- The ecological view: agricultural techniques must be environmentally sound;
- The economic view: agricultural techniques must be economically viable;
- The social view: agricultural techniques must be acceptable to farmers and society, given their culture, ethics and religion.

The psychological aspects of environmental degradation have a bearing on the current tendency towards participative management, since degradation processes trigger reactions such as apathy and disinterest, which impede participative management.

Even though in many countries environmental degradation is a serious problem, its psychological effects have received scant attention. The delineation of theoretical concepts and empirical indicators of sustainability of the physical environment is difficult. Mulders and Wiersum (1995) argue that definitions of ecological condition are plagued by confusion and various disciplines use different concepts and methods that cannot be easily reconciled.

Van Haften et al (1998a) based their studies of psychological consequences of environmental degradation in the Sahel on the concept of resilience (see **Figure 2.3.1**). They

found that environmental variables were shown to have a surprisingly high impact on human resilience and that the *level* of land degradation is psychologically more consequential than the rate. The resilience of land explained 88% of the variance of human resilience, and the environmental variables had a higher impact on women than on men. Later studies by these authors in China and on the Ivory Coast showed similar results.

It could be speculated that the role of psychological stress and marginalization levels on human communication follows a threshold model i.e. mild or moderate levels hardly influence communication, but beyond a certain critical level, these factors prohibit efficient communication. Research is needed to further specify these critical threshold values and to define social and psychological indicators that accompany high stress and marginalization levels.

Garret Hardin (1968) offered three policy choices for attaining sustainability, namely privatization, centralization and local control. Hardin's third choice (local control) appears to act rather differently from the first two, at least if democratic local government is to be the agency exercising control. As donors to developing countries seek to consolidate the 'democracy wave' of the last decade, there may be a considerable educative task ahead for environmentalists. Interventions that aim at an increase of security of tenure and the establishment of conditions favorable for sustainable land use may have no or even adverse effects, if they have no connection to the psychological dynamics of control of the land users in such situations.

Research findings in developing countries (Van Haaften & Van de Vijver, 1996) have important implications for attempts to stop or even reverse the degradation process. In areas in which the degradation has reached an advanced stage, it may be difficult to actively engage local people in programs addressing environmental degradation, since active participation by the local population is a prerequisite for effective intervention. High levels of degradation will have various social implications, which can easily become psychologically more important than the degrading environment. These may include the need to generate alternative income, the challenge to traditional roles in society, and dim future prospects.

In the Australian context, dry land salinity and low wool prices may be considered as significant psychological stressors which have marginalised sections of the rural population where these two factors act as drivers of change, there has been a significant shift toward maintaining viability through off-farm income, often through farm families' labour. This emerging new role has markedly changed the traditional role of both spouses in the nuclear family.

In summary, this chapter highlights the need to recognise the importance of cultural and societal norms as major determinants in the adoption of sustainable agricultural practices. It identifies the significance of the basic relationships between humans and

their natural resources and how these relations are affected by tenure. The shortcomings of production oriented agricultural education are explained and the way in which degradation-induced stress causes decreased participation in improvement programs is emphasised.

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Epilogue

Data obtained from more than 3000 interviews in six different cultures (Nia Boua and Agni in Ivory coast, the Fulani nomads and the farmers of the Dogon and Mossi cultures in Mali and Burkina Faso, and farmers in China) provided strong evidence that there is a quantifiable link between environmental carrying capacity and human resilience. The results suggest first of all that the psychological assessment procedures used work well in a wide variety of cultural contexts and that a strong relationship between environmental degradation and resilience is widespread, possibly even universal.

In first instance (Van Haaften & Van de Vijver, 1996), the research of psychological consequences of environmental degradation was based on the concept of carrying capacity. This concept originated in psychiatry and ecology (Kuiper & Van Zweden, 1973) and is often applied in systems theory to describe the resilience of a system to cope with substantial changes in the existing carrying load. The question can be raised to what extent the relationships of environmental, background and psychological variables will also be found elsewhere. Thus far, our studies have been carried out in the Sahel and China. The first attempts to cross-validate results are promising. Our study in Ivory Coast dealt with cultures highly dissimilar from the ones we studied in the Sahel. Yet we confirmed that individuals in the most degraded regions showed the highest stress and marginalization. Moreover, Lumsden (1975), Turnbull (1973), and De Bruin and Van Dijk (1995), all working in highly degraded environments, also observed behaviors that they associated with degradation. Further interdisciplinary research in the social and behavioral sciences would be needed to determine whether there is indeed a consistent set of social phenomena that all accompany degradation.

Other aspects of the topic of our study may turn out to be more culture-specific. This may hold in particular for the massive gender differences that we observed. Other cross-cultural research has also reported large gender differences in West African societies (Williams & Best, 1990). Although the data of China showed a similar result, replications elsewhere may well find less pronounced gender differences in the psychological outcome variables, when these are conducted in cultures with more gender equality.

Complex processes

Environmental degradation and its psychological correlates form an enduring process with mutual feedback loops. An environment that starts to erode induces psychological changes in behavior that will accelerate degradation. Strong feelings of marginalization can give rise to migration and to neglect of the environment, which induces accelerated degradation. However, the onset of erosion may also lead to behavior that will effectively cope with the threat of a loss of natural resources. The choice of coping strategy has implications for the management of natural resources. Unfortunately, we do not have much insight in the determinants of the choice or in the dynamics of the psychological processes associated with degradation processes. Additional anthropological research on

differences in stress and marginalization between gender groups and cultural groups is necessary.

Even if we have established a replicable, strong connection between resilience of land and humans, we do not yet understand the dynamics of the process that seems to make negative outcomes almost inevitable. Future studies will have to determine to what extent background and psychological variables will also show similar and replicable relationships to what we found. Adequate coping styles and internal locus of control are known to constitute important resources for dealing with problems in the environment. Avoidance may adversely affect psychological resilience in many places. An important issue in the external validity of our results may be resource competition. It could be argued that relationships between background and psychological variables of the eco-cultural model depend on the effectiveness of obtaining important resources, such as food, money, and access to land within a society. For example, among the Fulani the number of cattle owned was found to positively influence the carrying capacity (resilience) of both men and women. This may seem paradoxical: individuals with more cattle have to deal with more problems when the environment degrades. Yet, owning cattle also serves as social security and income guarantee: the more cattle one has, the longer one will be able to cope and survive. Subtle factors of a specific cultural context may modulate the relationship between cattle ownership and resilience. A similar argument may hold for other psychological and background variables.

Several issues require further scrutiny. Future studies may focus more on perceived control. It could be argued that the psychological measures used in the present study have control as a common theme, not just locus of control. Coping is obviously related to (re)gaining control. Control is also an important characteristic of marginalization, being the mental state in which individuals have lost control of their environment in an almost existential sense. Rothbaum, Weisz, and Snyder (1982) introduced a distinction between primary and secondary control. In primary control individuals act upon and change their environments, whereas in secondary control persons accommodate to conform to existing realities. Locus of control and coping refer to primary or secondary control. It could be argued that marginalization, seen as a lack of interest and motivation to change the environment or cognitions about the environment, constitutes a third type of control in which the environment is not changed and in which individuals do not accommodate. It may seem ironic at first sight to use the concept of control to refer to such an extreme form of lack of control. However, it is only in the comparison with other types of control that the essence of the concept of marginalization becomes comprehensible.

Men living in more degraded environments tend to use a more external locus of control. Combined with the finding that dwellers of more degraded environments revealed higher levels of stress and marginalization, the following picture emerges: very high levels of environmental degradation are accompanied by less active and more passive forms of dealing with such problems. Again, it can be conjectured that control is the key issue here: people are likely to display an active approach to environmental

degradation as long as the level of degradation is not beyond their control. However, when the degradation continues, people often withdraw from the situation either physically by moving to other areas or psychologically by relying more on passive strategies to deal with degradation. We found that the level of degradation is psychologically more important than the rate of the degradation.

Differences between pastoralists and agriculturalists were larger in the regions with the lowest level (and highest rate) of degradation. Pastoralists did not show such a strong variation of stress and marginalization scores than agriculturalists did. In the regions with less degradation, pastoralists scored high on both stress and marginalization compared to agriculturalists. This probably indicates a more marked shift in economic opportunities for pastoralists than for agriculturalists.

Environmental degradation seems to impose a settled way of farming and leaves no more room for a pastoral way of herding. A symbiosis of settled farmers and pastoral herders is then difficult to maintain. In the regions with the lower degradation the start of degradation is first perceived as stressful by the agriculturalists who realize much earlier that their means of existence are threatened, while the pastoralists still perceive that they can move away from the stressor. In the regions with a longer and higher state of degradation, the situation is reversed as the pastoralists have become much more cornered and dependent on the agriculturalists, who as the 'owners' of the natural resources (land and water) can easily restrict access for pastoralists.

It could be conjectured that the role of psychological stress and marginalization levels in sustainable management of natural resources follows a threshold model: mild or moderate levels will hardly influence communication. However, beyond a threshold level, these processes block efficient communication and interfere with management of the natural environment.

Future research will need to further specify critical threshold values and to define social and psychological indicators that signal high stress and marginalization levels. Management of natural resources below and above the threshold is likely to need wholly different approaches in order to be effective. Future research will need to address the suitability of this model. Although we may not yet be able to define the best management model vis-à-vis the psychological needs of local participants, it is obvious that these needs play an important role in any management of natural resources. The social and behavioral perspective is indispensable for adequate management.

A final area of further studies concerns the role of changes in vegetation for human resilience. Our studies have focused on soil degradation. However, degradation of vegetation may also be relevant, although it is very much linked to soil degradation. This type of degradation is likely to show a pronounced relationship with human resilience, because it deals with a type of degradation, that is easily visible.

Psychological stress and marginalization levels have significance for participative

management of natural resources in two ways. First, high levels of stress and marginalization can lower the motivation to invest efforts in environmental change and prohibit adequate communication; highly stressed and marginalized groups may well become inert and may cease to display coping behavior. Second, groups experiencing high levels of stress and marginalization will be psychologically vulnerable and susceptible to various psychological problems such as depression.

Cultural change, not only for farmers

In the past decades the scale of space for food production changed profoundly, due to technological change. For instance, in the Netherlands it means that agricultural industry has extended to more than seven times its own surface outside the country, spread all over the world. The reason for this is probably the low costs for growing and the lack of governmental control and regulation in remote and poor areas.

This phenomenon leads immediately to another area of research: agriculture has become a global activity, organized by multinational food industries. If those industries are interested in sustainable production of food, they should be interested in the knowledge of local farmers and nomads about their local ecosystems. They should be interested to know how they can link with local people and in the same time act and trade within the rules of human rights.

As is pointed out in **chapter 3.1**, there seems to be a historical bond between stakeholders and scientific groups, like between loggers and forest scientists. Those bonds seem to be within sectors that have their origins in the history of society and the members of those sectors seem to have similar attitudes towards nature. The question has to be raised if there exist attitudes towards nature or environmental beliefs that make human behavior secure and safe with respect to environmental degradation. This seems to be most the urgent question even for the near future. If we cannot find an answer for that question, a future should be envisaged in which an attitude of ruthless despotism without any consideration or respect for anything will irreversibly destroy the environment. In their environmental beliefs people reflect their opinion about reality. Theories about the relationship between humans and environment can be derived from natural and physical sciences (such as ecology and physics) or from social and behavioral sciences (e.g., economics). In the social sciences there is the ever-lasting discussion of humans as a part of nature versus humans and culture against nature, (e.g. nature-nurture discussion in psychology). It seems as if the human species inhabits two worlds. One is the natural world of plants and animals, of soils and airs and waters, which preceded our species by billions of years and of which he is a part. The other is the world of social institutions and artifacts humans builds for themselves, using tools and engines; and reflecting science and dreams to fashion an environment obedient to human purpose and direction (Arcury, 1990)

Theories about different attitudes toward nature often draw upon this dichotomy. Aspects of the idea of nature as a function of social organization and the way individuals

are caught up within systems of knowledge are too complex to be taken into account in this study of attitudes; yet, these should be an important perspective for further research within stakeholder cultures as well as disciplinary and professional cultures.

Farmers can be considered as the interface between culture and nature. And if they as a group are in trouble, the whole society is in trouble. From this perspective it is puzzling why environmental degradation is so hard to stop. Again one of the reasons is the changed scale of space. For current multinational food industries it has become much easier to escape from the rules that exist in their cultures of origin. As long as there is no 'new culture' to keep this kind of production within limits, degradation will not be counteracted. Not only does it destroy environments, but it also harms people living in it. It is as if each and every traditional culture are more able to deal with this problem than any of our western scientific cultures. It appears that each of our scientific cultures is generating partial solutions for environmental degradation based on a reduced perception of reality. Together with the technological changes the role of science within agriculture has grown and is noticeable all over the world. It is often not realized that application of scientific results in the real word has a lot of impact and always demands cultural change of the local stakeholders. At the same time science is fragmented and lacks integration; scientists are often even unable to cooperate and integrate their perspectives on research. This fragmented application of science can be dangerous. The assessment of psychological phenomena makes it possible to assess how demanding the situation has become for humans in degrading environments.

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Summary

Psychological aspects of environmental degradation have a bearing on current attempts to introduce participative and sustainable land and forest management. For example, degradation processes can trigger reactions, such as depression, which can impede participative management. Sustainable management of natural resources should take psychological factors into account.

Even though in many countries environmental degradation is a serious problem, its psychological aspects have received scant attention. The present study reports about an ongoing project in which I try to examine which psychological variables are involved in environmental degradation and how they interact with physical variables.

The central question put is:

Under what circumstances do farmers employ sustainable methods?

The concept of resilience (carrying capacity) of humans and land plays a crucial role in this thesis. The concept has having strong interdisciplinary aspects; the study addresses the psychological and biophysical perspectives, with the relationship of psychological and biophysical resilience as the central issue. The model is complex, due to the vast number of variables involved, and cannot be tested in a single project. Therefore, separate partial tests of the model have been carried out. I constrained the focus of research already in an early stage to the question of

‘When do farmers *not* employ sustainable methods?’

The different research missions concerned at first the applicability of the different standardized questionnaires of Stress, Marginalization, Depression, Locus of Control and Coping, starting with a training program for the local interviewers and making sure that the subjects were questioned in their local language. In a later stage close cooperation was established with soil scientists to inquire if there is a quantifiable relationship between soil indicators for land resilience and the psychological indicators for human resilience. To interrogate the dynamics of the processes that might go on the ecocultural model of John Berry (1992) was used, which I adapted to the connection between the cultural part and the ecological part.

After introducing the subject of this study, in **Section 1** the assessment of mainly the psychological part is reported.

In **Chapter 1.1** a central role in the model is played by human carrying capacity, the resilience to deal with consequences of environmental degradation. Stress and marginalization are taken as indicators of human resilience. A study in Côte d’Ivoire is described in which psychological stress and marginalization are studied among indivi-

duals living next to forests, which show different degrees of degradation. A first hypothesis stating that individuals living in or near a degrading forest are more stressed and marginalized than individuals in a reference group living in Abidjan was only confirmed for stress. A second hypothesis according to which people living near the forest with the most enduring and most severe degradation would report more stress and marginalization was confirmed. There were clear gender differences and females were more stressed and marginalized than males, as predicted.

In **Chapter 1.2** the psychological aspects of environmental degradation are further investigated among Sahel dwellers, which live in environments with different states of degradation. The soil scientists assessed resilience of land in terms of vegetation cover, erosion, and loss of organic matter. Subjects came from three cultural groups: Dogon agriculturalists, Mossi agriculturalists and Fulani pastoralists. Questionnaires of stress, marginalization, locus of control, and coping were administered. Environmental degradation was associated with higher levels of stress, marginalization, passive coping (avoidance), a more external locus of control, and lower levels of active coping (problem solving and support seeking). Compared to agriculturalists, pastoralists showed a stronger variation in all psychological variables across the least and most degraded regions. Women showed higher scores of stress, (external) locus of control, problem solving, and support seeking than men. The interaction of gender and region was significant for several variables. It was concluded that environmental degradation has various psychological correlates: people are likely to display an active approach to environmental degradation as long as the level of degradation is not beyond their control.

In **Chapter 1.3** the psychological aspects of environmental degradation were studied among 753 Chinese farmers. A good fit was found for a structural equation model postulating a relationship between various input variables (i.e., environmental degradation, socio-economic status, education, coping, and locus of control), a latent variable (called resilience), and three output variables (stress, marginalization, and depression). Higher scores on internal locus of control, problem solving, socioeconomic status, and modernity and lower scores on environmental degradation, avoidance, and support seeking were associated with more resilience.

Section 2 explores the interdisciplinary parts of the study. In **Chapter 2.1** disciplinary perception and interdisciplinary communication are considered to be vital conditions for effective application of scientific knowledge in achieving sustainable production of goods and services. Sustainable agricultural production is no exception and the problems in the agricultural sector are complex, only to be resolved through interdisciplinary cooperation. An adaptation of the ecocultural model of John Berry (1992), that is used to explain and approach interdisciplinary problems of sustainability, is shortly discussed. These universal problems are discussed in the context of sustainable agricultural production.

The professionals involved (researchers, managers, farmers, etc.) are addressed on an individual level as far as disciplinary backgrounds and the consequences for their

actual behavior are concerned. The influence of paradigms, scientific methodologies, attitudes towards nature and scales of time and space are discussed to explain disciplinary differences in perception of environmental degradation. Experiences in interdisciplinary teams appear to be similar to experiences in groups dealing with intercultural communication. Like groups of different cultural background, members of scientific disciplines deviate in perception according to their degree of 'relatedness' and the different types of interdisciplinarity are mentioned. Concluding interdisciplinarity at societal level is mentioned. In the western world scientific knowledge is organized within institutions, which often reinforce disciplinary and discourage the development of interdisciplinary communication. I demonstrate the possibilities with an interdisciplinary study of resilience of humans as well as land.

In **Chapter 2.2** the interdisciplinary concept of resilience (carrying capacity) is the central issue. The relationship between psychological and biophysical resilience among Fulani pastoralists in the Sahel is the focus of study. Three contrasting regions were assessed in terms of vegetation cover, erosion, and loss of organic matter. The indicators of psychological resilience were psychological stress and marginalization.

A structural equation model of the relationship between psychological and biophysical indicators was fitted to the data. A good fit was found for a model in which both the biophysical and the psychological indicators define their own underlying latent variable. 88% of the variance of the psychological latent variable 'human resilience' (human carrying capacity) was explained by the biophysical latent variable 'resilience of land' (carrying capacity of land). A multivariate analysis was carried out, with gender and region as independent variables and stress and marginalization as dependent variables. Individuals in more degraded regions reported more stress and marginalization. Men scored higher on marginalization and lower on stress than women.

The data point to a close link between biophysical and psychological indicators, thereby underlining the fruitfulness of an interdisciplinary approach to resilience (carrying capacity). The results also have implications for participative approaches to the management of land.

Chapter 2.3 highlights the need to recognize the importance of Land Care and Culture, Attitudes towards Nature, Aspirations, Values and Criteria of Stewardship achievements, Tenure and Farming Systems, Balance between regulations, Incentives and education, Adaptation to environmental and cultural change, as major determinants in the adoption of sustainable agricultural practices. It identifies the significance of the basic relationships between humans and their natural resources and how these relations are affected by tenure. The shortcomings of production oriented agricultural education are explained and the way in which degradation-induced stress causes decreased participation in improvement programs is emphasized. In this way is elaborated on how farming beyond 2000 will develop.

The **Epilogue** describes future research necessary to obtain sustainable management of natural resources. Environmental degradation and its psychological aspects form an enduring process with mutual feedback loops. An environment that starts to erode induces psychological changes in behavior that will accelerate degradation. Strong feelings of marginalization can give rise to migration and to neglect of the environment, which induces accelerated degradation. However, the onset of erosion may also lead to behavior that will effectively cope with the threat of a loss of natural resources. The choice of coping strategy has implications for the management of natural resources. Unfortunately, we do not have much insight in the determinants of the choice or in the dynamics of the psychological processes associated with degradation processes. Additional anthropological research on differences in stress and marginalization between gender groups and cultural groups is necessary.

Even if we can establish a replicable, strong connection between resilience of land and humans, we do not yet understand the dynamics of the process that seems to make negative outcomes almost inevitable. Future studies will have to determine to what extent background and psychological variables will also show similar and replicable relationships to what we found.

In the past decades the scale of space for food production changed profoundly, due to technical change. This phenomenon leads immediately to an important area of future research: agriculture has become a global activity, organized by multinational food industries. If those industries are interested in sustainable production of food, they should be interested in the knowledge of local farmers and nomads on their local ecosystems. How they can link with those local people and in the same time act and trade within the rules of human rights is a large area of research for the coming decades.

Samenvatting

Psychologische aspecten van omgevingsdegradatie hebben hun weerslag op de huidige pogingen om participatief beheer van duurzaam landgebruik en bosbeheer te introduceren. Degradatieprocessen kunnen bijvoorbeeld reacties als depressie en marginalisatie teweeg brengen, welke participatief beheer onmogelijk maken. Duurzaam beheer van natuurlijke hulpbronnen zou rekening moeten houden met psychologische factoren. Hoewel omgevingsdegradatie in veel landen een serieus probleem is hebben de psychologische kanten ervan weinig aandacht. Deze studie doet verslag van een lopend project, waarin ik onderzoek welke psychologische variabelen een rol spelen in omgevingsdegradatie en hoe die samenhangen met fysieke variabelen.

De centrale vraag daarbij is:

Onder welke omstandigheden gebruiken boeren duurzame productie methoden?

Het concept van veerkracht (draagkracht) van mens en bodem speelt daarbij een doorslaggevende rol. Het concept heeft sterk interdisciplinaire aspecten; de studie richt zich op de biologische en biofysische perspectieven, met de relatie tussen psychologische en biofysische veerkracht als centraal onderwerp. Het gebruikte model is complex vanwege het grote aantal variabelen dat betrokken is en kan niet binnen één project worden getest. Daarom zijn afzonderlijke deel testen van het model gedaan.

Reeds in een vroeg stadium van onderzoek heb ik de centrale onderzoeksvraag beperkt tot de vraag:

Wanneer gebruiken boeren *geen* duurzame productie methoden?

In eerste instantie richtten de onderzoeksmissies zich op de toepassingsmogelijkheden van de verschillende gestandaardiseerde vragenlijsten van Stress, Marginalisatie, Depressie, Controlebesef (Locus of Control) en Stresshantering (Coping), met als begin een trainingsprogramma voor de lokale interviewers, dat zeker stelde dat alle deelnemers aan het onderzoek in hun locale taal ondervraagd werden. In een later stadium werd nauwe samenwerking gezocht met bodemkundigen om te onderzoeken of er een te kwantificeren relatie bestaat tussen indicatoren voor de veerkracht van bodems en voor de psychologische veerkracht van mensen. Om de dynamiek van de in gang zijnde processen te onderzoeken is het eco-culturele model van John Berry (1992) gebruikt, dat ik zodanig aanpaste dat de relatie tussen het culturele deel en het ecologische deel van het model gelegd kon worden.

Na de introductie van het onderwerp van deze studie, worden in **Deel 1** de onderzoeksresultaten van het psychologische deel gerapporteerd.

In **Hoofdstuk 1.1** ligt de nadruk binnen het model op menselijke draagkracht, de

veerkracht om het hoofd te bieden aan de gevolgen van omgevingsdegradatie. Stress en marginalisatie worden gebruikt als indicatoren voor menselijke veerkracht. Het beschrijft een studie in Ivoorkust, waarbij psychologische stress en marginalisatie zijn bestudeerd bij individuen, afhankelijk van bossen met een verschillende mate van degradatie. Een eerste hypothese, die stelde dat individuen, die leven in of vlak naast een degraderend bos, meer last hebben van stress en marginalisatie dan individuen van een referentie groep in Abidjan, werd alleen bevestigd voor stress. Een tweede hypothese die stelde dat mensen, die bij het meest langdurig en meest degraderende bos leven, meer stress en marginalisatie zouden rapporteren, werd bevestigd. Er waren duidelijke verschillen tussen de geslachten en vrouwen hadden meer last van stress en marginalisatie, zoals voorspeld.

In **Hoofdstuk 1.2** worden de psychologische aspecten van omgevingsdegradatie verder onderzocht onder bewoners van de Sahel, die leven in omgevingen, die in een verschillende staat van degradatie verkeren. De bodemkundigen stelden de veerkracht van de bodems vast in termen van vegetatie bedekking, erosie, en verlies van organische stof. De deelnemers aan het onderzoek kwamen uit drie culturele groepen: sedentaire Dogon boeren, sedentaire Mossie boeren en nomadische Fulani veehouders. De vragenlijsten van stress, marginalisatie, controlebesef (locus of control), en stresshantering (coping) werden afgenomen. Omgevingsdegradatie leverde hogere niveaus van stress, marginalisatie, passieve stresshantering (vermijding), extern controlebesef (locus of control), en lagere niveaus van actieve stresshantering (probleem oplossing en sociale steun zoeken). Vergeleken bij de boeren, toonden de nomadische veehouders een grotere variantie bij alle psychologische variabelen in alle gebieden. Vrouwen toonden meer stress, (extern) controlebesef (locus of control), probleem oplossen en steun zoeken dan mannen. De interactie tussen geslacht en regio was significant voor verschillende variabelen. De conclusie was dat omgevingsdegradatie op verschillende wijze samenhangt met de menselijke psyche: mensen zullen actief omgaan met omgevingsdegradatie zo lang het niveau van degradatie niet hun macht of controle te boven gaat.

Hoofdstuk 1.3 beschrijft studie van de psychologische aspecten van psychologische degradatie bij 753 Chinese boeren. Passend was een model dat de relatie aanneemt tussen verschillende output variabelen (m.n. omgevingsdegradatie, sociaal economische status, onderwijs, stresshantering en controlebesef, een latente variabele (veerkracht genoemd), en drie output variabelen (stress, marginalisatie, en depressie). Hogere waarden bij interne controlebesef, probleem oplossen, socio-economische status, en moderniteit en lagere waarden bij steun zoeken werden in verband gebracht met meer veerkracht.

Deel 2 gaat in op de interdisciplinaire delen van de studie. In **Hoofdstuk 2.1** worden disciplinaire perceptie en interdisciplinaire communicatie beschouwd als de vitale voorwaarden voor effectieve toepassing van wetenschappelijke kennis voor duurzame productie van goederen en diensten. Duurzame landbouw productie is daarop geen uitzondering. De problemen in de landbouwsector zijn complex en kunnen uitsluitend wor-

den opgelost wanneer interdisciplinaire samenwerking mogelijk is. Een aanpassing van het eco-culturele model van John Berry (1992), dat is gebruikt om de interdisciplinaire problemen van duurzaamheid uit te leggen, wordt kort besproken. Deze universele problemen worden besproken binnen de context van duurzame landbouw productie.

De betrokken beroepsgroepen (onderzoekers, managers, boeren, enzovoort) worden aangesproken op een individueel niveau voor zover het hun disciplinaire achtergrond en de gevolgen daarvan voor hun gedrag betreft. De invloed van paradigma's, wetenschappelijke methodologie, houdingen ten opzichte van de natuur, en schaal van tijd en ruimte worden besproken om disciplinaire verschillen in de perceptie van omgevingsdegradatie uit te leggen. Experimenten in interdisciplinaire teams blijken overeen te komen met ervaringen in groepen die het hoofd bieden aan interculturele communicatie. Overeenkomstig met groepen met verschillende culturele achtergrond, wijkt de perceptie van leden van wetenschappelijke disciplines af overeenkomstig hun 'verwantschap' en de verschillende typen van interdisciplinariteit worden genoemd. Concluderend wordt interdisciplinariteit op het niveau van de samenleving genoemd. In de westerse wereld is wetenschappelijke kennis geïnstitutionaliseerd binnen instituties, die vaak disciplinariteit versterken en interdisciplinaire communicatie ontmoedigen. De mogelijkheden van interactie worden gedemonstreerd met een interdisciplinaire studie naar de veerkracht van zowel mensen als land.

In **Hoofdstuk 2.2** is het interdisciplinaire concept veerkracht (draagkracht) het centrale onderwerp. De relatie tussen psychologische en biofysische veerkracht bij de nomadische Fulani veehouders in de Sahel is het centrale onderwerp van deze studie. Goed passend was het model waarin zowel de biofysische als de psychologische indicatoren hun eigen latente variabele definiëren. 88% van de variantie van de psychologische latente variabele 'menselijke veerkracht' (menselijke draagkracht) werd verklaard door de biofysische latente variabele 'veerkracht van land' (draagkracht van land). Uit een multivariate analyse met geslacht en regio als onafhankelijke variabelen bleek dat mannen hoger scoorden op marginalisatie en lager op stress dan vrouwen.

De data duiden op een nauwe betrekking tussen biofysische en psychologische indicatoren en ondersteunen daarmee de vruchtbaarheid van een interdisciplinaire benadering van veerkracht (draagkracht).

De resultaten hebben implicaties voor participatieve benaderingen van beheer van land.

Hoofdstuk 2.3 belicht de behoefte om het belang van Land Care en Cultuur, Houdingen tegenover de Natuur, Aspiraties, Waarden en Criteria voor Rentmeesterschap, Bezit en Farming Systems, Balans in Regelgeving, Stimulans en Onderwijs, Aanpassing aan Verandering van de fysieke en culturele omgeving te erkennen als belangrijke bepalende factoren te erkennen voor de adoptie van duurzame landbouwkundige toepassingen. Daarmee wordt de betekenis van de fundamentele relaties tussen mensen en hun natuurlijke hulpbronnen geïdentificeerd en hoe deze relaties worden beïnvloed door bezit. De tekortkomingen van eenzijdig productiegericht landbouw-

kundig onderwijs worden uiteengezet evenals de wijze waarop door degradatie geïnduceerde stress participatie in programma's voor verbetering hindert. Op deze wijze wordt uiteengezet hoe het boerenbedrijf na 2000 zich zal ontwikkelen.

De Epiloog beschrijft welk toekomstig onderzoek nodig is om te komen tot duurzaam beheer van natuurlijke hulpbronnen. Omgevingsdegradatie en de bijbehorende psychologische aspecten zijn een blijvend proces met terugkoppelende mechanismen. Een omgeving die begint te eroderen veroorzaakt veranderingen in psychologische gedrag die de degradatie versnelt. Sterke gevoelens van marginalisatie kunnen aanleiding geven tot migratie en tot verwaarlozing van de omgeving, wat weer degradatie versnelt. Het begin van erosie echter kan ook leiden tot gedrag dat effectief omgaat met de bedreiging van verlies van natuurlijke hulpbronnen. Welke strategie van stresshantering wordt gekozen heeft implicaties voor het beheer van natuurlijke hulpbronnen. Helaas hebben we niet veel inzicht in welke beslissende factoren die keuze bepalen of in de dynamiek van de psychologische processen die zijn verbonden met degradatie processen. Aanvullend antropologisch onderzoek naar de verschillen in stress en marginalisatie tussen geslachts- en culturele groepen is noodzakelijk.

Zelfs als we een herhaalbare, sterke relatie tussen veerkracht van land en mensen kunnen vaststellen, begrijpen we nog steeds niet de dynamiek van het proces dat een negatief resultaat bijna onontkoombaar maakt. Toekomstig onderzoek zal moeten vaststellen in welke mate achtergrond en psychologische variabelen vergelijkbare en herhaalbare relaties vertoont met wat ik gevonden heb.

In de afgelopen decennia is de schaal van ruimte voor de voedselproductie grondig veranderd, veroorzaakt door technologie verandering. Dit fenomeen leidt onmiddellijk tot een belangrijk onderwerp van toekomstig onderzoek: landbouw is een wereldomvattende activiteit geworden, georganiseerd door multinationale voedsel industrieën. Indien deze industrieën zich iets gelegen laten liggen aan duurzame productie van voedsel, dan zijn ze geïnteresseerd in de kennis van lokale boeren en nomaden ten aanzien van hun lokale ecosystemen. Hoe zij een verbinding kunnen maken met deze lokale groepen en tegelijkertijd kunnen handelen binnen de regels van de mensenrechten is een groot gebied van onderzoek voor de komende decennia.



The field team in China



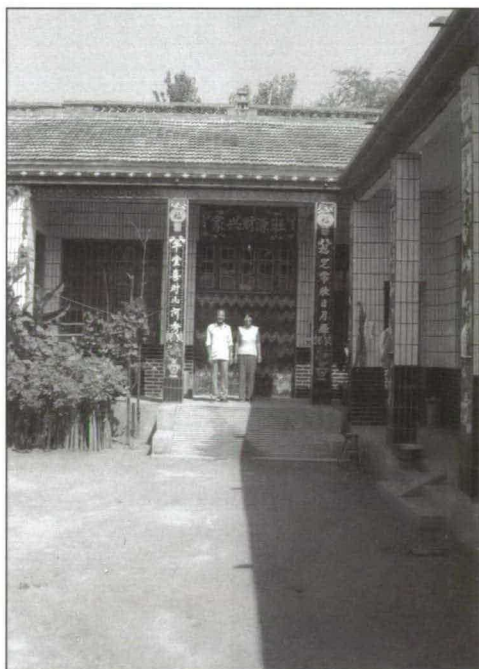
Research station in Quzhou area in China



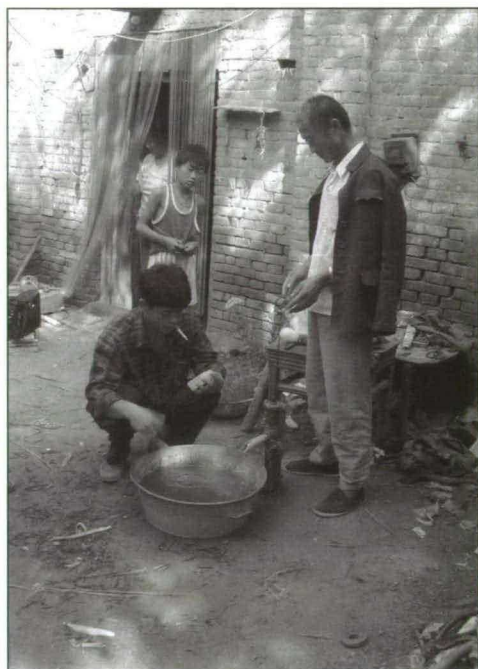
Sampling soil by soil scientists



Image in little temple in China



Farmhouse in China



Sampling water by soil scientists



E. Heleen van Haften concentrates her research in Africa, Asia and Europe where she studies the psychological reaction of land users on environmental degradation together with soil scientists, agronomists, ecologists and foresters. Recently she started research in the Netherlands to see what impact the mouth and foot disease had on the mental resilience of farmers. Linking the data from the different disciplines in order to understand the dynamics of social sustainability in an empirical way is her main contribution to the agricultural sciences.

She got her degree in Agricultural Sociology in the Wageningen Agricultural University. Her first field work was a research experience in the land reform in Chile in 1969, what was decisive for her interest in cultural change and acculturative stress. In 1980 she got the opportunity to lecture cross-cultural psychology in the department of Psychology in the Wageningen Agricultural University and concentrated on the communication processes in the co-operation between the western development expert and his or her local counterpart in developing countries. Since 1989 she did research for the Forestry Department on the psychological consequences of environmental degradation in Indonesia, Burkina Faso and Côte d'Ivoire. Also in the Department of Forestry she developed a training course for as well Dutch as foreign students to study the environmental problems in Dutch regions from the viewpoint of intercultural and interdisciplinary communication. In 1997 she could extend her research to China where the relation between salinization of soils and water is linked to psychological well-being. Since 2001 she is doing research in Europe.

Heleen van Haften (1944) studied not-western sociology at the Wageningen University. Her master's thesis concerned the consequences of Land Reform in Chile.